Allen-Bradley

MicroLogix™ 1200 Programmable Controllers

Bulletin 1762 Controllers and Expansion I/O

User Manual

Rockwell Automation

File Name: AB_ProgrammableController_1762_L24_L40_user_D1100

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Rockwell Automation publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Rockwell Automation office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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Throughout this manual we use notes to make you aware of safety considerations:

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss

Attention statements help you to:

- identify a hazard
- avoid a hazard
- recognize the consequences

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

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Modbus is a trademark of Modicon, Inc.

The information below summarizes the changes to this manual since the last printing.

To help you find new and updated information in this release of the manual, we have included change bars as shown to the right of this paragraph.

The table below lists the sections that document new features and additional or updated information about existing features.

For this information	See
1762-L24BXB, 1762-L40BXB controllers description wiring specifications	 page 1-2 pages 3-8 and 3-8, 3-12 through 3-15 Appendix A
Expansion I/O new module descriptions wiring diagrams for new modules expanded specifications	 page 1-3 pages 3-17 through 3-20, and 3-24 Appendix A
Analog expansion I/O module error codes	Appendix C
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Glossary

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Read this preface to familiarize yourself with the rest of the manual. It provides information concerning:

- who should use this manual
- the purpose of this manual
- related documentation
- conventions used in this manual
- Rockwell Automation support

Who Should Use this Manual

Use this manual if you are responsible for designing, installing, programming, or troubleshooting control systems that use MicroLogix™ 1200 controllers.

You should have a basic understanding of electrical circuitry and familiarity with relay logic. If you do not, obtain the proper training before using this product.

Purpose of this Manual

This manual is a reference guide for MicroLogix 1200 controllers and expansion I/O. It describes the procedures you use to install, wire, and troubleshoot your controller. This manual:

- explains how to install and wire your controllers
- gives you an overview of the MicroLogix 1200 controller system

Refer to Publication 1762-RM001C-EN-P, *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual* for the MicroLogix 1200 and 1500 instruction set and for application examples to show the instruction set in use. Refer to your RSLogix 500 programming software user documentation for more information on programming your MicroLogix 1200 controller.

Related Documentation

The following documents contain additional information concerning Rockwell Automation products. To obtain a copy, contact your local Rockwell Automation office or distributor.

For	Read this Document	Document Number
Information on understanding and applying micro controllers.	MicroMentor	1761-MMB
Information on the MicroLogix 1200 Controllers instruction set.	MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual	1762-RM001C-EN-P
Information on mounting and wiring the MicroLogix 1200 Controllers, including a mounting template for easy installation.	MicroLogix 1200 Programmable Controllers Installation Instructions	1762-IN006C-MU-P
A description on how to install and connect an AIC+. This manual also contains information on network wiring.	Advanced Interface Converter (AIC+) User Manual	1761-6.4
Information on how to install, configure, and commission a DNI.	DeviceNet™ Interface User Manual	1761-6.5
Information on DF1 open protocol.	DF1 Protocol and Command Set Reference Manual	1770-6.5.16
Information about the Modbus Slave protocol.	Modbus Protocol Specifications	Available from Schneider Automation, Inc.
In-depth information on grounding and wiring Allen-Bradley programmable controllers.	Allen-Bradley Programmable Controller Grounding and Wiring Guidelines	1770-4.1
A description of important differences between solid-state programmable controller products and hard-wired electromechanical devices.	Application Considerations for Solid-State Controls	SGI-1.1
An article on wire sizes and types for grounding electrical equipment.	National Electrical Code - Published by the National Fire Protection Association of Boston, MA.	
A complete listing of current documentation, including ordering instructions. Also indicates whether the documents are available on CD-ROM or in multi-languages.	Allen-Bradley Publication Index	SD499
A glossary of industrial automation terms and abbreviations.	Allen-Bradley Industrial Automation Glossary	AG-7.1

Common Techniques Used in this Manual

The following conventions are used throughout this manual:

- Bulleted lists such as this one provide information, not procedural steps.
- Numbered lists provide sequential steps or hierarchical information.
- *Italic* type is used for emphasis.

Rockwell Automation Support

Rockwell Automation offers support services worldwide, with over 75 Sales/Support Offices, 512 authorized Distributors and 260 authorized Systems Integrators located throughout the United States alone, plus Rockwell Automation representatives in every major country in the world.

Local Product Support

Contact your local Rockwell Automation representative for:

- sales and order support
- product technical training
- warranty support
- support service agreements

Technical Product Assistance

If you need to contact Rockwell Automation for technical assistance, please review the information in the *Troubleshooting* appendix first. Then call your local Rockwell Automation representative.

Your Questions or Comments on this Manual

If you find a problem with this manual, or you have any suggestions for how this manual could be made more useful to you, please contact us at the address below:

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Milwaukee, WI 53201-2086

or visit our internet page at: http://www.ab.com/micrologix

Hardware Overview

Hardware Features

The Bulletin 1762, MicroLogix 1200 programmable controller contains a power supply, input and output circuits, and a processor. The controller is available in 24 I/O and 40 I/O configurations.

The hardware features of the controller are:

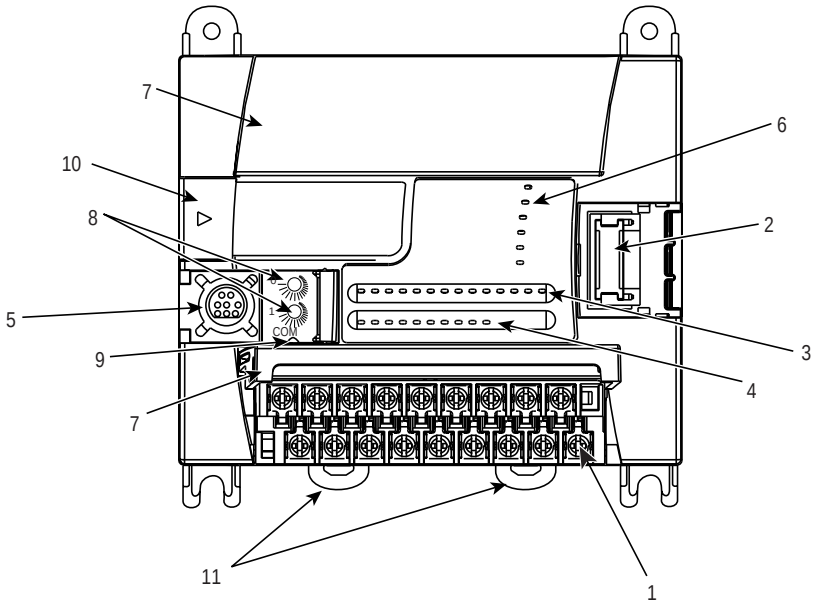


Table 1.1 Hardware Features

Feature	Description	Feature	Description
1	Terminal Blocks (Removable Terminal Blocks 1762-L40xWA and 1762-L40BXB, only)	7	Terminal Doors and Labels
2	Bus Connector Interface to Expansion I/O	8	Trim Pots
3	Input LEDs	9	Communications Toggle Push Button
4	Output LEDs	10	Memory Module Port Cover(1) -or- Memory Module and/or Real-Time Clock(2)
5	Communication Port/ Channel 0	11	DIN Rail Latches
6	Status LEDs		

(1) Shipped with controller.

(2) Optional equipment.

Table 1.2 Controller Input Power and Embedded I/O

Catalog Number	Description		
	Input Power	Inputs	Outputs
1762-L24AWA	120/240V ac	(14) 120V ac	(10) relay
1762-L24BWA	120/240V ac	(10) 24V dc (4) fast 24V dc	(10) relay
1762-L24BXB	24V dc	(10) 24V dc (4) fast 24V dc	(5) relay, (4) 24V dc FET (1) high-speed 24V dc FET
1762-L40AWA	120/240V ac	(24) 120V ac	(16) relay
1762-L40BWA	120/240V ac	(20) 24V dc (4) fast 24V dc	(16) relay
1762-L40BXB	24V dc	(20) 24V dc (4) fast 24V dc	(8) relay, (7) 24V dc FET (1) high-speed 24V dc FET

Component Descriptions

MicroLogix 1200 Memory Module and/or Real-Time Clock

The controller is shipped with a memory module port cover in place. You can order a memory module, real-time clock, or memory module and real-time clock as an accessory.

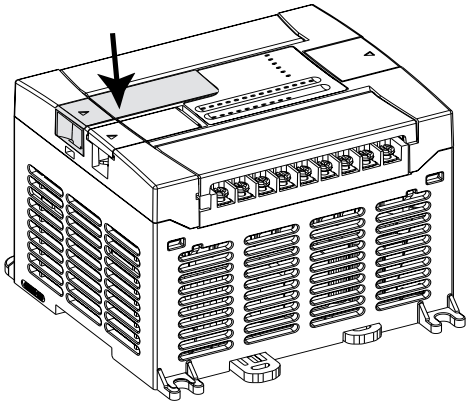


Table 1.3 Memory Module and/or Real-Time Clock

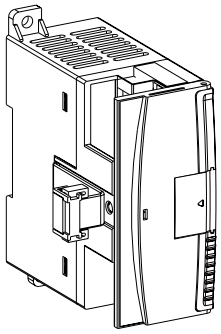
Catalog Number	Descriptions
1762-MM1	Memory Module only
1762-RTC	Real-Time Clock only
1762-MM1RTC	Memory Module and Real-Time Clock

1762 Expansion I/O

1762 expansion I/O can be connected to the MicroLogix 1200 controller, as shown below.

NOTE A maximum of six I/O modules, in certain combinations, may be connected to a controller. See Appendix F System Loading and Heat Dissipation to determine valid combinations.

1762 Expansion I/O



1762 Expansion I/O Connected to MicroLogix 1200 Controller

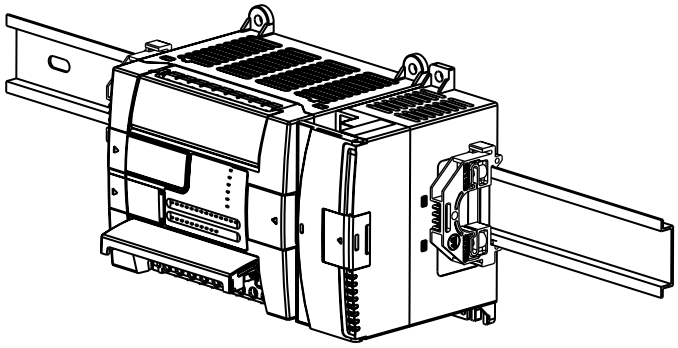


Table 1.4 Expansion I/O

Catalog Number	Descriptions
1762-IA8	8-Point 120V ac Input
1762-IQ8	8-Point Sink/Source 24V dc Input
1762-IQ16	16-Point Sink/Source 24V dc Input
1762-OA8	8-Point AC Triac Output
1762-OB8	8-Point Sourcing 24V dc Output
1762-OB16	16-Point Sourcing 24V dc Output
1762-OW8	8-Point AC/DC Relay Output
1762-OW16	16-Point AC/DC Relay Output
1762-IF2OF2	2-Channel Analog Voltage/Current Input 2-Channel Analog Voltage/Current Output
1762-IF4	4-Channel Analog Voltage/Current Input

Communication Cables

Use only the following communication cables with the MicroLogix 1200 controllers.

- 1761-CBL-PM02 Series C or later
- 1761-CBL-HM02 Series C or later
- 1761-CBL-AM00 Series C or later
- 1761-CBL-AP00 Series C or later
- 2707-NC8 Series A or later
- 2702-NC9 Series B or later
- 2707-NC10 Series B or later
- 2707-NC11 Series B or later

Programming

Programming the MicroLogix 1200 programmable controller is done using RSLogix™ 500, Revision 4 or later. You must use Revision 4.5 or later of RSLogix™ 500 in order to use the new features of the Series B MicroLogix 1200 controllers, including the full ASCII instruction set. Communication cables for programming are not included with the software.

NOTE Series C or higher cables are required.

Communication Options

The MicroLogix 1200 can be connected to a personal computer. It can also be connected to the DH485 network using an Advanced Interface Converter (catalog number 1761-NET-AIC) and to the DeviceNet™ network using a DeviceNet Interface (catalog number 1761-NET-DNI). The controller can also be connected to DF1 Half Duplex or Modbus™ SCADA networks as an RTU slave. Series B controllers may also be connected to serial devices using ASCII. See **Chapter 4 Communication Connections** for more information on connecting to the available communication options.

Installing Your Controller

This chapter shows you how to install your controller. The only tools you require are a flat or Phillips head screwdriver and drill. Topics include:

- agency certifications
- compliance to European Union Directives
- installation considerations
- safety considerations
- power considerations
- preventing excessive heat
- master control relay
- installing the memory module and/or real-time clock
- controller mounting dimensions
- controller and expansion I/O spacing
- mounting the controller
- mounting 1762 expansion I/O
- connecting 1762 expansion I/O

Agency Certifications

- UL 508
- C-UL under CSA C22.2 no. 142
- Class I, Division 2, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 no. 213)
- CE compliant for all applicable directives
- C-Tick compliant for all applicable acts.

Compliance to European Union Directives

This product has the CE mark and is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2
  EMC - Generic Emission Standard, Part 2 - Industrial Environment
- EN 50082-2
  EMC - Generic Immunity Standard, Part 2 - Industrial Environment

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 - Equipment Requirements and Tests.

For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- *Industrial Automation Wiring and Grounding Guidelines for Noise Immunity*, publication 1770-4.1
- *Guidelines for Handling Lithium Batteries*, publication AG-5.4
- *Automation Systems Catalog*, publication B113

Installation Considerations

Most applications require installation in an industrial enclosure (Pollution Degree 2[1]) to reduce the effects of electrical interference (Over Voltage Category II[2]) and environmental exposure. Locate your controller as far as possible from power lines, load lines, and other sources of electrical noise such as hard-contact switches, relays, and AC motor drives. For more information on proper grounding guidelines, see the *Industrial Automation Wiring and Grounding Guidelines* publication 1770-4.1.

ATTENTION

Vertical mounting of the controller is not recommended due to heat build-up considerations.

ATTENTION

Be careful of metal chips when drilling mounting holes for your controller or other equipment within the enclosure or panel. Drilled fragments that fall into the controller or I/O modules could cause damage. Do not drill holes above a mounted controller if the protective debris shields are removed or the processor is installed.

(1) Pollution Degree 2 is an environment where normally only non-conductive pollution occurs except that occasionally temporary conductivity caused by condensation shall be expected.

(2) Overvoltage Category II is the load level section of the electrical distribution system. At this level, transient voltages are controlled and do not exceed the impulse voltage capability of the products insulation.

Safety Considerations

Safety considerations are an important element of proper system installation. Actively thinking about the safety of yourself and others, as well as the condition of your equipment, is of primary importance. We recommend reviewing the following safety considerations.

Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following WARNING statement applies to use in hazardous locations.

WARNING

EXPLOSION HAZARD

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace components or disconnect equipment unless power has been switched off.
- Do not connect or disconnect components unless power has been switched off.
- This product must be installed in an enclosure. All cables connected to the product must remain in the enclosure or be protected by conduit or other means.
- All wiring must comply with N.E.C. article 501-4(b).

Use only the following communication cables in Class I, Division 2 hazardous locations.

Environment Classification	Communication Cables
Class I, Division 2 Hazardous Environment	1761-CBL-PM02 Series C or later
	1761-CBL-HM02 Series C or later
	1761-CBL-AM00 Series C or later
	1761-CBL-AP00 Series C or later
	2707-NC8 Series A or later
	2707-NC9 Series B or later
	2707-NC10 Series B or later
	2707-NC11 Series B or later

Disconnecting Main Power

WARNING

Explosion Hazard - Do not replace components or disconnect equipment unless power has been switched off.

The main power disconnect switch should be located where operators and maintenance personnel have quick and easy access to it. In addition to disconnecting electrical power, all other sources of power (pneumatic and hydraulic) should be de-energized before working on a machine or process controlled by a controller.

Safety Circuits

WARNING

Explosion Hazard - Do not connect or disconnect connectors while circuit is live.

Circuits installed on the machine for safety reasons, like overtravel limit switches, stop push buttons, and interlocks, should always be hard-wired directly to the master control relay. These devices must be wired in series so that when any one device opens, the master control relay is de-energized, thereby removing power to the machine. Never alter these circuits to defeat their function. Serious injury or machine damage could result.

Power Distribution

There are some points about power distribution that you should know:

- The master control relay must be able to inhibit all machine motion by removing power to the machine I/O devices when the relay is de-energized. It is recommended that the controller remain powered even when the master control relay is de-energized.
- If you are using a dc power supply, interrupt the load side rather than the ac line power. This avoids the additional delay of power supply turn-off. The dc power supply should be powered directly from the fused secondary of the transformer. Power to the dc input and output circuits should be connected through a set of master control relay contacts.

Periodic Tests of Master Control Relay Circuit

Any part can fail, including the switches in a master control relay circuit. The failure of one of these switches would most likely cause an open circuit, which would be a safe power-off failure. However, if one of these switches shorts out, it no longer provides any safety protection. These switches should be tested periodically to assure they will stop machine motion when needed.

Power Considerations

The following explains power considerations for the micro controllers.

Isolation Transformers

You may want to use an isolation transformer in the ac line to the controller. This type of transformer provides isolation from your power distribution system to reduce the electrical noise that enters the controller and is often used as a step-down transformer to reduce line voltage. Any transformer used with the controller must have a sufficient power rating for its load. The power rating is expressed in volt-amperes (VA).

Power Supply Inrush

During power-up, the MicroLogix 1200 power supply allows a brief inrush current to charge internal capacitors. Many power lines and control transformers can supply inrush current for a brief time. If the power source cannot supply this inrush current, the source voltage may sag momentarily.

The only effect of limited inrush current and voltage sag on the MicroLogix 1200 is that the power supply capacitors charge more slowly. However, the effect of a voltage sag on other equipment should be considered. For example, a deep voltage sag may reset a computer connected to the same power source. The following considerations determine whether the power source must be required to supply high inrush current:

- The power-up sequence of devices in a system.
- The amount of the power source voltage sag if the inrush current cannot be supplied.
- The effect of voltage sag on other equipment in the system.

If the entire system is powered-up at the same time, a brief sag in the power source voltage typically will not affect any equipment.

Loss of Power Source

The power supply is designed to withstand brief power losses without affecting the operation of the system. The time the system is operational during power loss is called "program scan hold-up time after loss of power." The duration of the power supply hold-up time depends on the type and state of the I/O, but is typically between 10 milliseconds and 3 seconds. When the duration of power loss reaches this limit, the power supply signals the processor that it can no longer provide adequate dc power to the system. This is referred to as a power supply shutdown. The processor then performs an orderly shutdown of the controller.

Input States on Power Down

The power supply hold-up time as described above is generally longer than the turn-on and turn-off times of the inputs. Because of this, the input state change from "On" to "Off" that occurs when power is removed may be recorded by the processor before the power supply shuts down the system. Understanding this concept is important. The user program should be written to take this effect into account.

Other Types of Line Conditions

Occasionally the power source to the system can be temporarily interrupted. It is also possible that the voltage level may drop substantially below the normal line voltage range for a period of time. Both of these conditions are considered to be a loss of power for the system.

Preventing Excessive Heat

For most applications, normal convective cooling keeps the controller within the specified operating range. Ensure that the specified temperature range is maintained. Proper spacing of components within an enclosure is usually sufficient for heat dissipation.

In some applications, a substantial amount of heat is produced by other equipment inside or outside the enclosure. In this case, place blower fans inside the enclosure to assist in air circulation and to reduce "hot spots" near the controller.

Additional cooling provisions might be necessary when high ambient temperatures are encountered.

NOTE Do not bring in unfiltered outside air. Place the controller in an enclosure to protect it from a corrosive atmosphere. Harmful contaminants or dirt could cause improper operation or damage to components. In extreme cases, you may need to use air conditioning to protect against heat build-up within the enclosure.

Master Control Relay

A hard-wired master control relay (MCR) provides a reliable means for emergency machine shutdown. Since the master control relay allows the placement of several emergency-stop switches in different locations, its installation is important from a safety standpoint. Overtravel limit switches or mushroom-head push buttons are wired in series so that when any of them opens, the master control relay is de-energized. This removes power to input and output device circuits. Refer to the figures on pages 2-10 and 2-11.

ATTENTION

Never alter these circuits to defeat their function since serious injury and/or machine damage could result.

NOTE

If you are using an external dc power supply, interrupt the dc output side rather than the ac line side of the supply to avoid the additional delay of power supply turn-off.

The ac line of the dc output power supply should be fused.

Connect a set of master control relays in series with the dc power supplying the input and output circuits.

Place the main power disconnect switch where operators and maintenance personnel have quick and easy access to it. If you mount a disconnect switch inside the controller enclosure, place the switch operating handle on the outside of the enclosure, so that you can disconnect power without opening the enclosure.

Whenever any of the emergency-stop switches are opened, power to input and output devices should be removed.

When you use the master control relay to remove power from the external I/O circuits, power continues to be provided to the controller's power supply so that diagnostic indicators on the processor can still be observed.

The master control relay is not a substitute for a disconnect to the controller. It is intended for any situation where the operator must quickly de-energize I/O devices only. When inspecting or installing terminal connections, replacing output fuses, or working on equipment within the enclosure, use the disconnect to shut off power to the rest of the system.

NOTE Do not control the master control relay with the controller. Provide the operator with the safety of a direct connection between an emergency-stop switch and the master control relay.

Using Emergency-Stop Switches

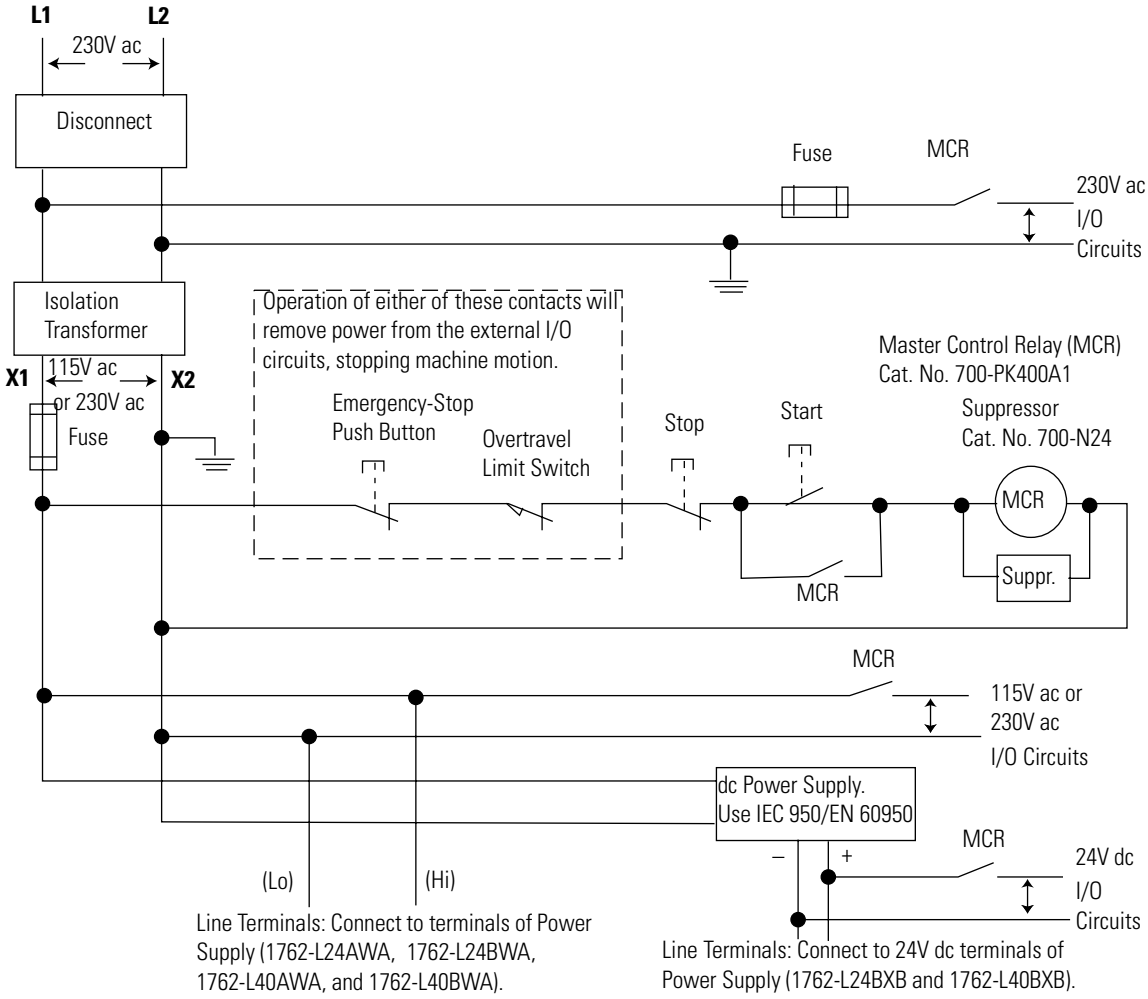
When using emergency-stop switches, adhere to the following points:

- Do not program emergency-stop switches in the controller program. Any emergency-stop switch should turn off all machine power by turning off the master control relay.
- Observe all applicable local codes concerning the placement and labeling of emergency-stop switches.
- Install emergency-stop switches and the master control relay in your system. Make certain that relay contacts have a sufficient rating for your application. Emergency-stop switches must be easy to reach.
- In the following illustration, input and output circuits are shown with MCR protection. However, in most applications, only output circuits require MCR protection.

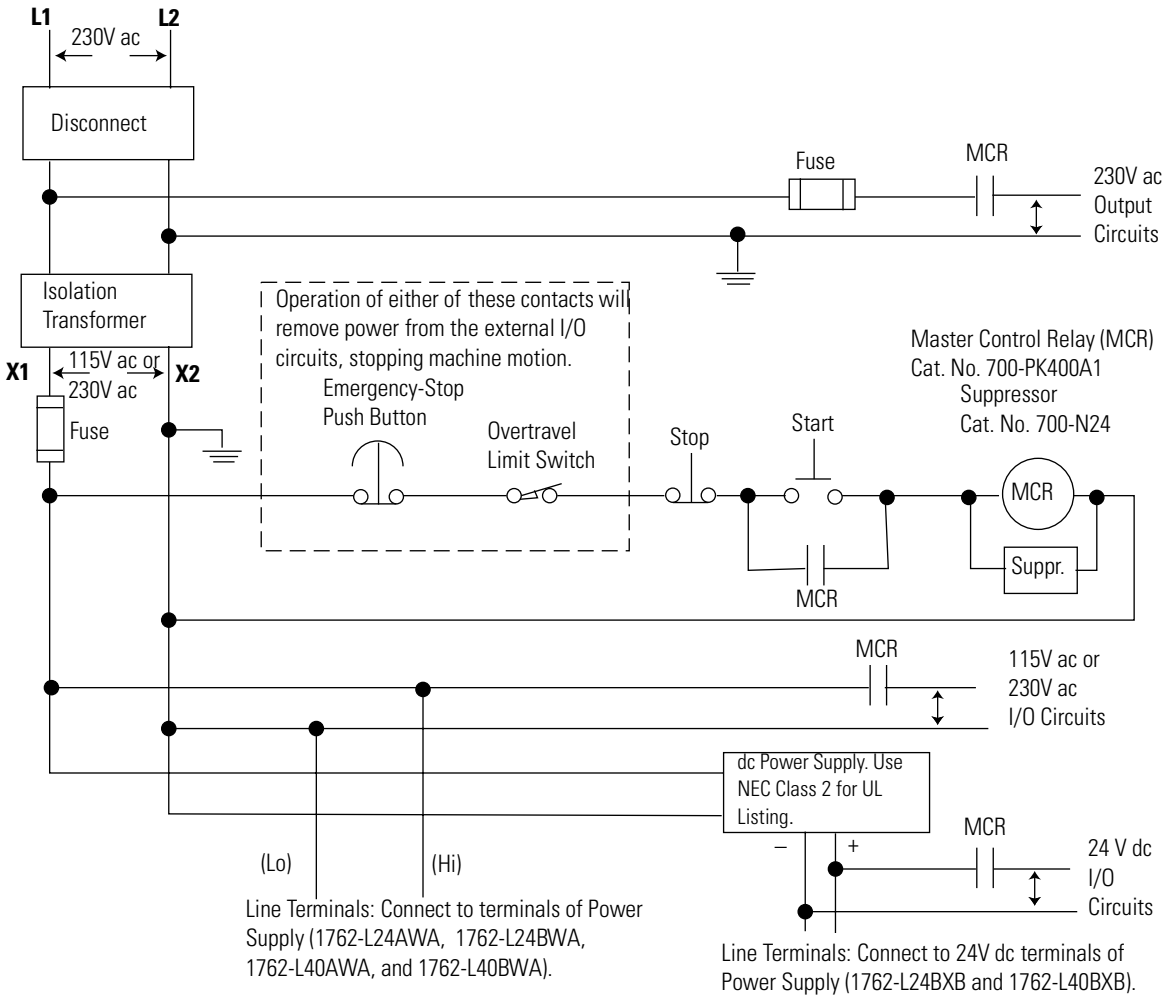
The following illustrations show the Master Control Relay wired in a grounded system.

NOTE In most applications input circuits do not require MCR protection; however, if you need to remove power from all field devices, you must include MCR contacts in series with input power wiring.

Schematic (Using IEC Symbols)

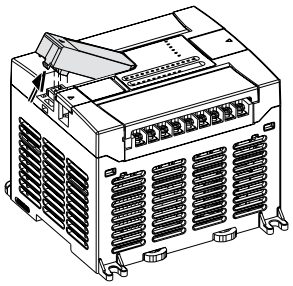


Schematic (Using ANSI/CSA Symbols)

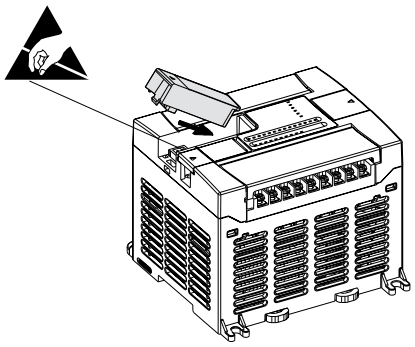


Installing a Memory Module and/or Real-Time Clock

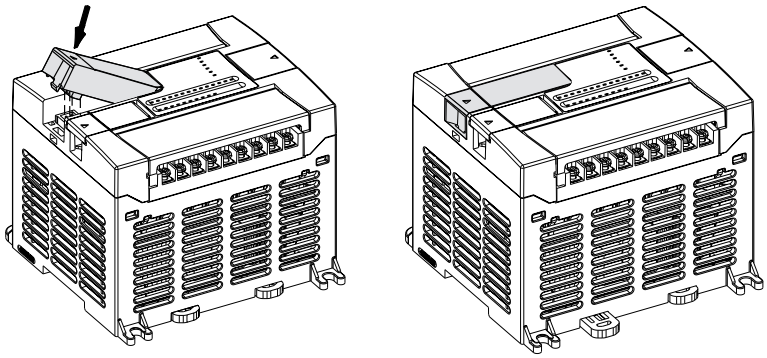
1. Remove the memory module port cover.



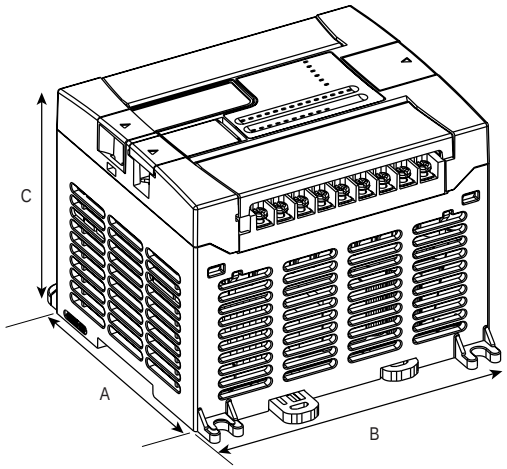
2. Align the connector on the memory module with the connector pins on the controller.



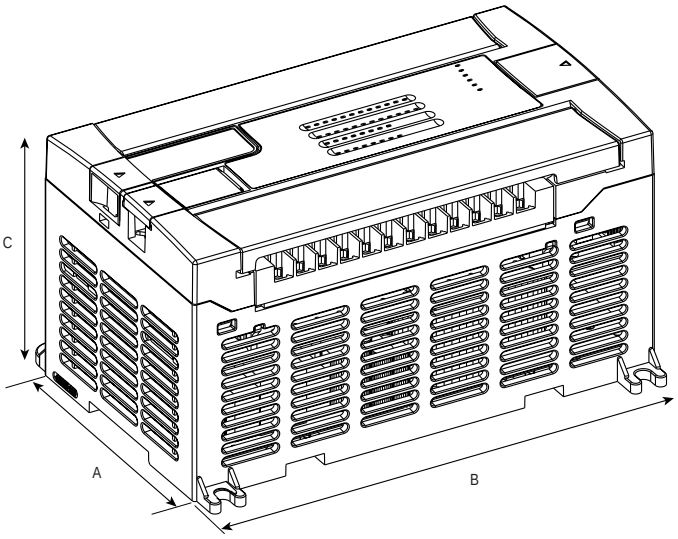
3. Firmly seat the memory module into the controller.



Controller Mounting Dimensions



1762-L24AWA, 1762-L24BWA, 1762-L24BXB



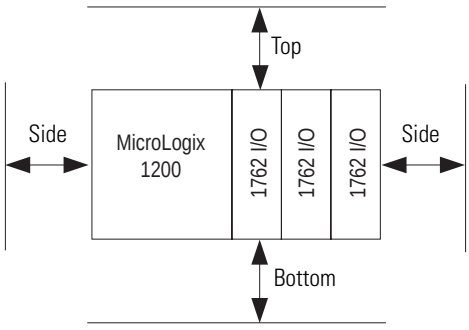
1762-L40AWA, 1762-L40BWA, 1762-L40BXB

Table 2.1 Controller Dimensions

Dimension	1762-L24AWA	1762-L24BWA	1762-L24BXB	1762-L40AWA	1762-L40BWA	1762-L40BXB
A	90 mm (3.5 in.)			90 mm (3.5 in.)		
B	110 mm (4.33 in.)			160 mm (6.30 in.)		
C	87 mm (3.43 in.)			87 mm (3.43 in.)		

Controller and Expansion I/O Spacing

The controller mounts horizontally, with the expansion I/O extending to the right of the controller. Allow 50 mm (2 in.) of space on all sides of the controller system for adequate ventilation. Maintain spacing from enclosure walls, wireways, adjacent equipment, etc., as shown below.

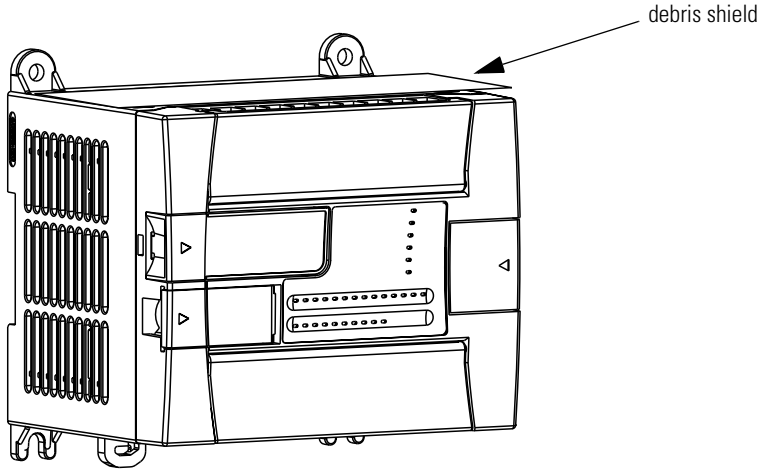


Mounting the Controller

MicroLogix™ 1200 controllers are suitable for use in an industrial environment when installed in accordance with these instructions. Specifically, this equipment is intended for use in clean, dry environments (Pollution degree 2[1]) and to circuits not exceeding Over Voltage Category II[2] (IEC 60664-1).[3]

ATTENTION

Do not remove the protective debris shield until after the controller and all other equipment in the panel near the controller are mounted and wiring is complete. Once wiring is complete, remove protective debris shield. Failure to remove shield before operating can cause overheating.



ATTENTION

Electrostatic discharge can damage semiconductor devices inside the controller. Do not touch the connector pins or other sensitive areas.

NOTE

For environments with greater vibration and shock concerns, use the panel mounting method described on page 2-16, rather than DIN rail mounting.

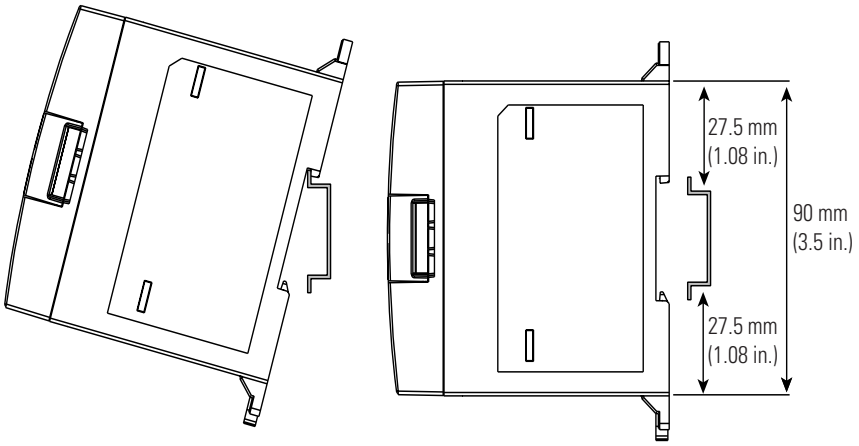
(1) Pollution Degree 2 is an environment where, normally, only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation shall be expected.

(2) Over Voltage Category II is the load level section of the electrical distribution system. At this level transient voltages are controlled and do not exceed the impulse voltage capability of the product's insulation.

(3) Pollution Degree 2 and Over Voltage Category II are International Electrotechnical Commission (IEC) designations.

DIN Rail Mounting

The maximum extension of the latch is 14 mm (0.55 in.) in the open position. A flat-blade screwdriver is required for removal of the controller. The controller can be mounted to EN50022-35x7.5 or EN50022-35x15 DIN rails. DIN rail mounting dimensions are shown below.

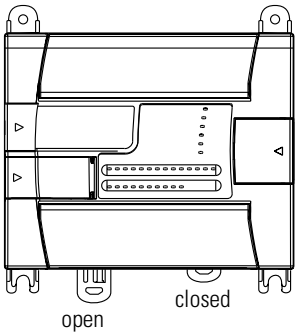


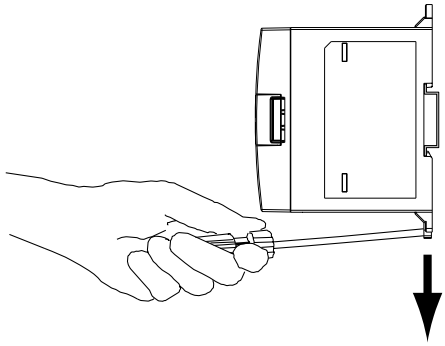
To install your controller on the DIN rail:

1. Mount your DIN rail. (Make sure that the placement of the controller on the DIN rail meets the recommended spacing requirements, see Controller and Expansion I/O Spacing on page 2-13. Refer to the mounting template inside the back cover of this document.)
2. Close the DIN latch, if it is open.
3. Hook the top slot over the DIN rail.
4. While pressing the controller down against the top of the rail, snap the bottom of the controller into position.
5. Leave the protective debris shield attached until you are finished wiring the controller and any other devices.

To remove your controller from the DIN rail:

1. Place a flat-blade screwdriver in the DIN rail latch at the bottom of the controller.
2. Holding the controller, pry downward on the latch until the latch locks in the open position.
3. Repeat steps 1 and 2 for the second DIN rail latch.
4. Unhook the top of the DIN rail slot from the rail.

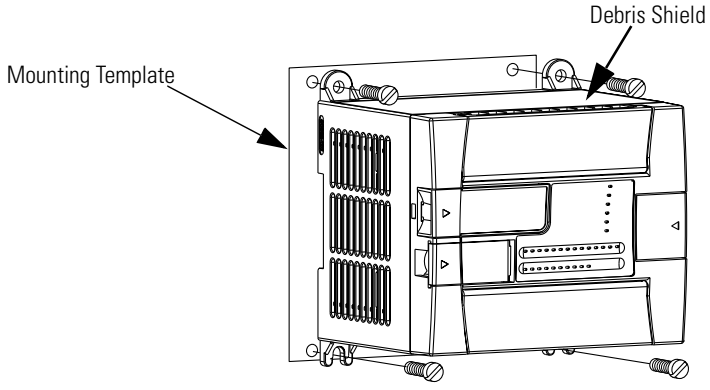




Panel Mounting

Mount to panel using #8 or M4 screws. To install your controller using mounting screws:

1. Remove the mounting template from inside the back cover of the *MicroLogix 1200 Programmable Controllers Installation Instructions*, publication 1762-IN006C-MU-P.
2. Secure the template to the mounting surface. (Make sure your controller is spaced properly. See Controller and Expansion I/O Spacing on page 2-13.)
3. Drill holes through the template.
4. Remove the mounting template.
5. Mount the controller.
6. Leave the protective debris shield in place until you are finished wiring the controller and any other devices.



1762 Expansion I/O Dimensions

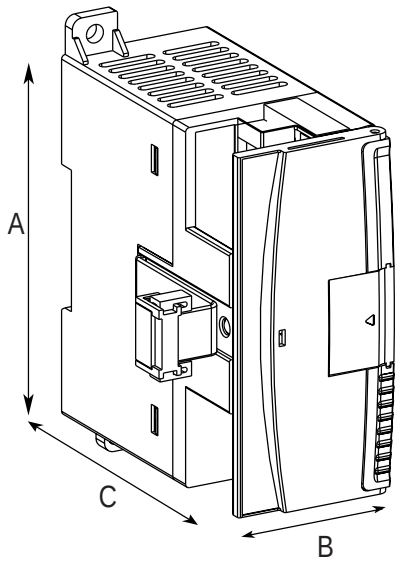


Table 2.2

Dimension	Expansion I/O Module
A	90 mm (3.5 in.)
B	40 mm (1.57 in.)
C	87 mm (3.43 in.)

Mounting 1762 Expansion I/O

ATTENTION

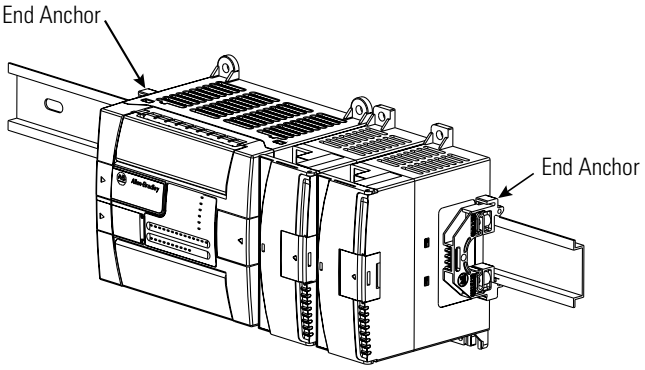
During panel or DIN rail mounting of all devices, be sure that all debris (metal chips, wire stands, etc.) is kept from falling into the module. Debris that falls into the module could cause damage when the module is under power.

DIN Rail Mounting

The module can be mounted using the following DIN rails: 35 x 7.5 mm (EN 50 022 - 35 x 7.5) or 35 x 15 mm (EN 50 022 - 35 x 15).

Before mounting the module on a DIN rail, close the DIN rail latch. Press the DIN rail mounting area of the module against the DIN rail. The latch momentarily opens and locks into place.

Use DIN rail end anchors (Allen-Bradley part number 1492-EA35 or 1492-EAH35) for vibration or shock environments. The following illustration shows the location of the end anchors.

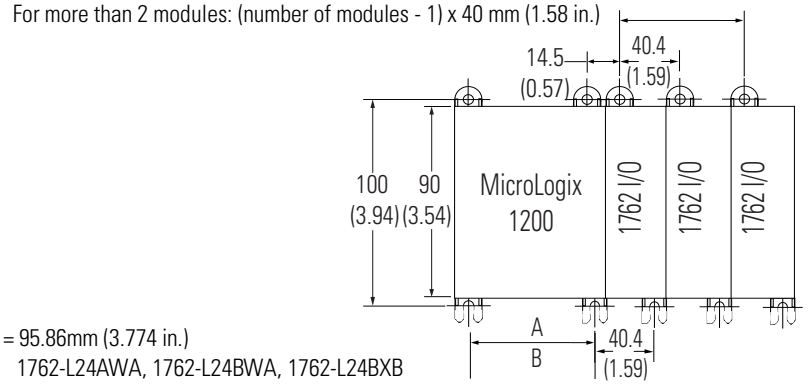


NOTE 1762 expansion I/O must be mounted horizontally as illustrated.

NOTE For environments with greater vibration and shock concerns, use the panel mounting method described below, instead of DIN rail mounting.

Panel Mounting

Use the dimensional template shown below to mount the module. The preferred mounting method is to use two M4 or #8 panhead screws per module. M3.5 or #6 panhead screws may also be used, but a washer is needed to ensure a good mechanical contact. Mounting screws are required on every module.



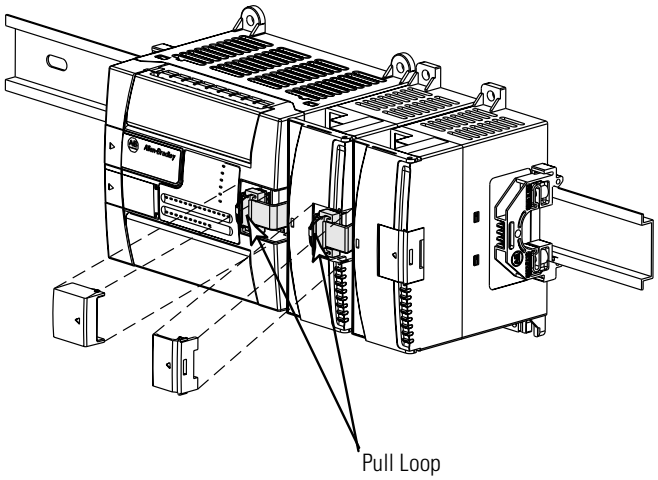
A = 95.86mm (3.774 in.)
1762-L24AWA, 1762-L24BWA, 1762-L24BXB

B = 145.8 mm (5.739 in.)
1762-L40AWA, 1762-L40BWA, 1762-L40BXB

NOTE: All dimensions are in mm (inches). Hole spacing tolerance: ±0.4 mm (0.016 in.).

Connecting Expansion I/O

The expansion I/O module is attached to the controller or another I/O module by means of a flat ribbon cable *after* mounting, as shown below.



NOTE Use the pull loop on the connector to disconnect modules. Do not pull on the ribbon cable.

NOTE Up to six expansion I/O modules can be connected to a controller depending upon the power supply loading.

ATTENTION

Remove power before removing or inserting an I/O module. When you remove or insert a module with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing the controller to fault
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance, reducing product reliability.

WARNING

EXPLOSION HAZARD

In Class I, Division 2 applications, the bus connector must be fully seated and the bus connector cover must be snapped in place.

In Class I, Division 2 applications, all modules must be mounted in direct contact with each other as shown on page 2-19. If DIN rail mounting is used, an end stop must be installed ahead of the controller and after the last 1762 I/O module.

Wiring Your Controller

This chapter describes how to wire your controller and expansion I/O. Topics include:

- wire requirements
- using surge suppressors
- grounding the controller
- wiring diagrams
- sinking and sourcing wiring diagrams
- controller I/O wiring
- expansion I/O wiring

Wiring Requirements

Wiring Recommendation

ATTENTION

Before you install and wire any device, disconnect power to the controller system.

ATTENTION

Calculate the maximum possible current in each power and common wire. Observe all electrical codes dictating the maximum current allowable for each wire size. Current above the maximum ratings may cause wiring to overheat, which can cause damage.

United States Only: If the controller is installed within a potentially hazardous environment, all wiring must comply with the requirements stated in the National Electrical Code 501-4 (b).

- Allow for at least 50 mm. (2 in.) between I/O wiring ducts or terminal strips and the controller.
- Route incoming power to the controller by a path separate from the device wiring. Where paths must cross, their intersection should be perpendicular.

NOTE Do not run signal or communications wiring and power wiring in the same conduit. Wires with different signal characteristics should be routed by separate paths.

- Separate wiring by signal type. Bundle wiring with similar electrical characteristics together.
- Separate input wiring from output wiring.
- Label wiring to all devices in the system. Use tape, shrink-tubing, or other dependable means for labeling purposes. In addition to labeling, use colored insulation to identify wiring based on signal characteristics. For example, you may use blue for dc wiring and red for ac wiring.

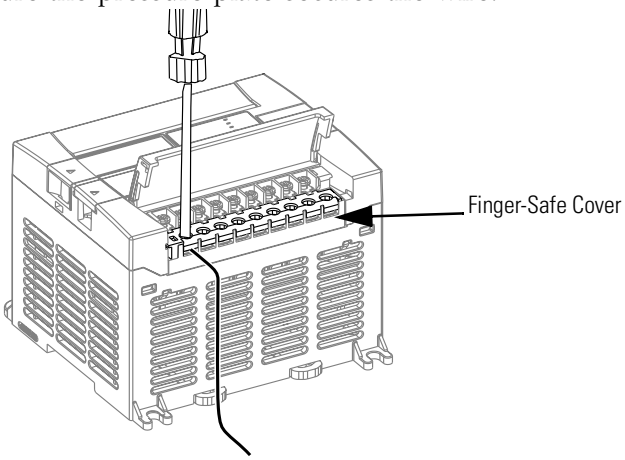
Table 3.1 Wire Requirements

Wire Type		Wire Size (2 wire maximum per terminal screw)
Solid	Cu-90°C (194°F)	#14 to #22 AWG
Stranded	Cu-90°C (194°F)	#16 to #22 AWG

Wiring torque = 0.791 Nm (7 in-lb) rated

Wiring without Spade Lugs

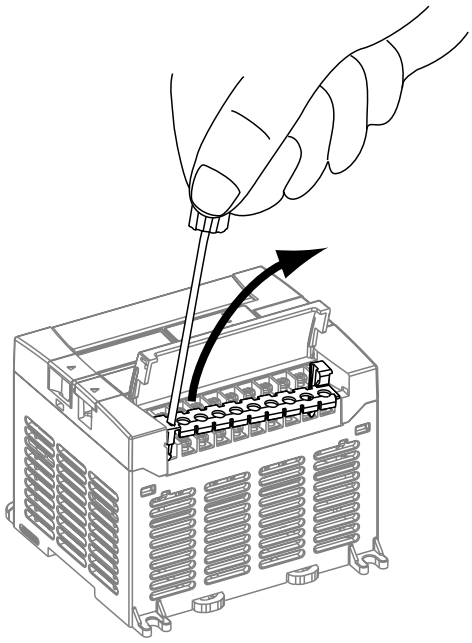
When wiring without spade lugs, it is recommended to keep the finger-safe covers in place. Loosen the terminal screw and route the wires through the opening in the finger-safe cover. Tighten the terminal screw making sure the pressure plate secures the wire.



Wiring with Spade Lugs

The diameter of the terminal screw head is 5.5 mm (0.220 in.). The input and output terminals of the MicroLogix 1200 controller are designed for a 6.35mm (0.25 in.) wide spade (standard for #6 screw for up to 14 AWG) or a 4 mm (metric #4) fork terminal.

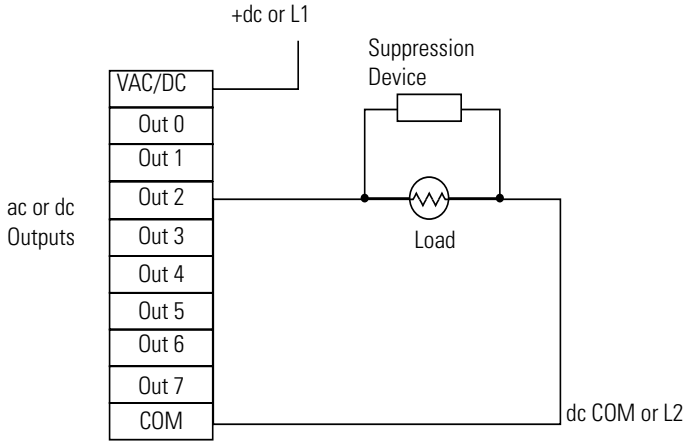
When using spade lugs, use a small, flat-blade screwdriver to pry the finger-safe cover from the terminal blocks as shown below. Then loosen the terminal screw.



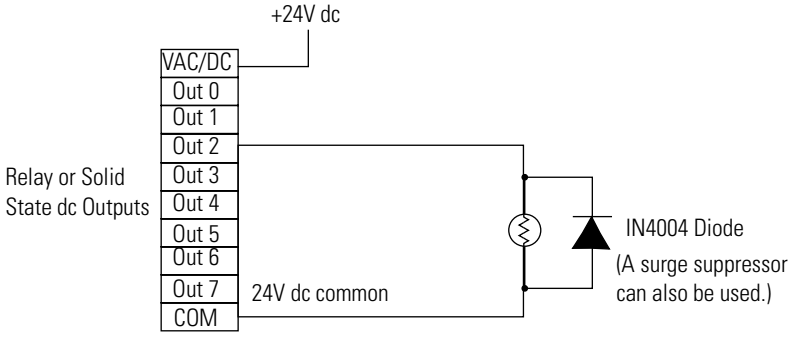
Using Surge Suppressors

Inductive load devices, such as motor starters and solenoids, require the use of some type of surge suppression to protect and extend the operating life of the controllers output contacts. Switching inductive loads without surge suppression can *significantly* reduce the life expectancy of relay contacts. By adding a suppression device directly across the coil of an inductive device, you prolong the life of the output or relay contacts. You also reduce the effects of voltage transients and electrical noise from radiating into adjacent systems.

The following diagram shows an output with a suppression device. We recommend that you locate the suppression device as close as possible to the load device.

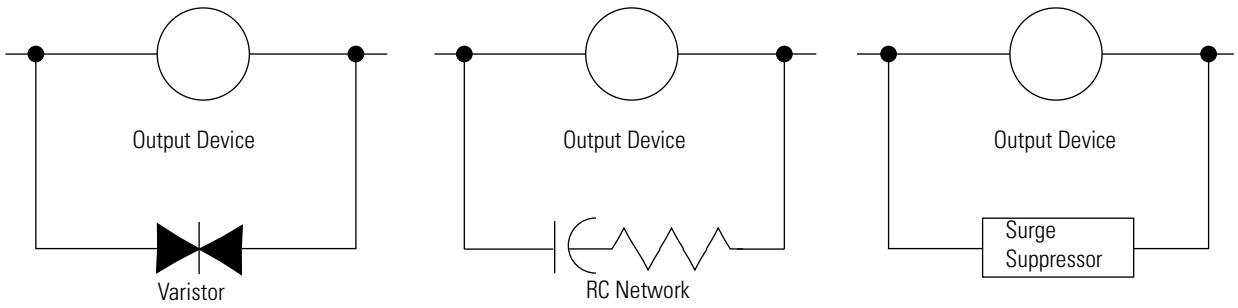


If the outputs are dc, we recommend that you use an 1N4004 diode for surge suppression, as shown below. For inductive dc load devices, a diode is suitable. A 1N4004 diode is acceptable for most applications. A surge suppressor can also be used. See Table 3.2 for recommended suppressors. As shown below, these surge suppression circuits connect directly across the load device.



Suitable surge suppression methods for inductive ac load devices include a varistor, an RC network, or an Allen-Bradley surge suppressor, all shown below. These components must be appropriately rated to suppress the switching transient characteristic of the particular inductive device. See the table on page 3-5 for recommended suppressors.

Surge Suppression for Inductive ac Load Devices



Recommended Surge Suppressors

Use the Allen-Bradley surge suppressors shown in the following table for use with relays, contactors, and starters.

Table 3.2 Recommended Surge Suppressors

Device	Coil Voltage	Suppressor Catalog Number
Bulletin 509 Motor Starter Bulletin 509 Motor Starter	120V ac 240V ac	599-K04(1) 599-KA04(1)
Bulletin 100 Contactor Bulletin 100 Contactor	120V ac 240V ac	199-FSMA1(2) 199-FSMA2(2)
Bulletin 709 Motor Starter	120V ac	1401-N10(2)
Bulletin 700 Type R, RM Relays	ac coil	None Required
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	12V dc 12V dc	199-FSMA9
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	24V dc 24V dc	199-FSMA9
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	48V dc 48V dc	199-FSMA9
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	115-125V dc 115-125V dc	199-FSMA10
Bulletin 700 Type R Relay Bulletin 700 Type RM Relay	230-250V dc 230-250V dc	199-FSMA11
Bulletin 700 Type N, P, or PK Relay	150V max, ac or DC	700-N24(2)
Miscellaneous electromagnetic devices limited to 35 sealed VA	150V max, ac or DC	700-N24(2)

(1) Varistor – Not recommended for use on relay outputs.

(2) RC Type – Do not use with Triac outputs.

Grounding the Controller

In solid-state control systems, grounding and wire routing helps limit the effects of noise due to electromagnetic interference (EMI). Run the ground connection from the ground screw of the controller to the ground bus prior to connecting any devices. Use AWG #14 wire. For AC-powered controllers, this connection must be made for safety purposes.

ATTENTION

All devices connected to the RS-232 channel must be referenced to controller ground, or be floating (not referenced to a potential other than ground). Failure to follow this procedure may result in property damage or personal injury.

- For 1762-L24BWA and 1762-L40BWA controllers:

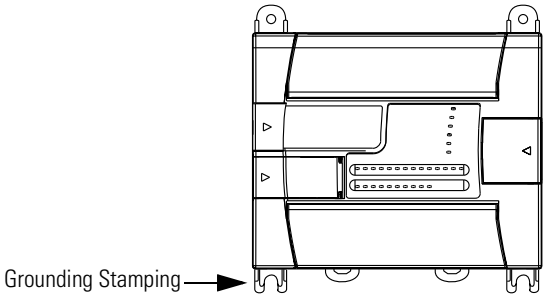
  The COM of the sensor supply is also connected to chassis ground internally. The 24V dc sensor power source should not be used to power output circuits. It should only be used to power input devices.

- For 1762-L24BXB and 1762-L40BXB controllers:

  The VDC NEUT or common terminal of the power supply is also connected to chassis ground internally.

This product is intended to be mounted to a well grounded mounting surface such as a metal panel. Refer to the *Industrial Automation Wiring and Grounding Guidelines,* publication 1770-4.1, for additional information. Additional grounding connections from the mounting tab or DIN rail, if used, are not required unless the mounting surface cannot be grounded.

NOTE It is recommended to use all four mounting positions for panel mounting installation.



ATTENTION

Remove the protective debris strip before applying power to the controller. Failure to remove the strip may cause the controller to overheat.

Wiring Diagrams

The following illustrations show the wiring diagrams for the MicroLogix 1200 controllers. Controllers with dc inputs can be wired as either sinking or sourcing inputs. (Sinking and sourcing does not apply to ac inputs.) Refer to Sinking and Sourcing Wiring Diagrams on page 3-10

The controller terminal block layouts are shown below. The shading on the labels indicates how the terminals are grouped. A detail of the groupings is shown in the table following the terminal block layouts.

NOTE

This ⏚ symbol denotes a protective earth ground terminal which provides a low impedance path between electrical circuits and earth for safety purposes and provides noise immunity improvement. This connection must be made for safety purposes on ac-powered controllers.

This ⏚ symbol denotes a functional earth ground terminal which provides a low impedance path between electrical circuits and earth for non-safety purposes, such as noise immunity improvement.

Terminal Block Layouts

Figure 3.1 1762-L24AWA

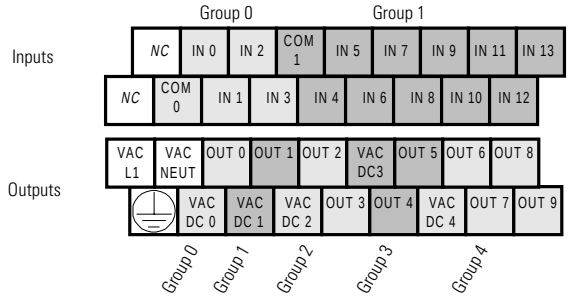
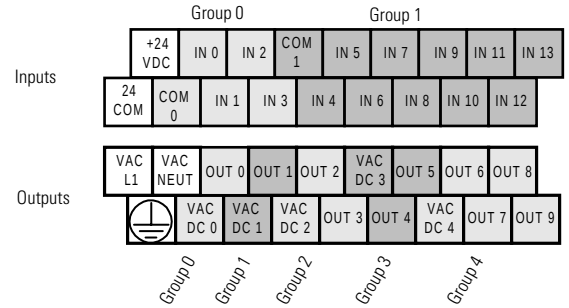


Figure 3.2 1762-L24BWA



ATTENTION

The 24V dc sensor supply of the 1762-L24BWA should not be used to power output circuits. It should only be used to power input devices (e.g. sensors, switches). See Master Control Relay on page 2-8 for information on MCR wiring in output circuits.

Figure 3.3 1762-L24BXB

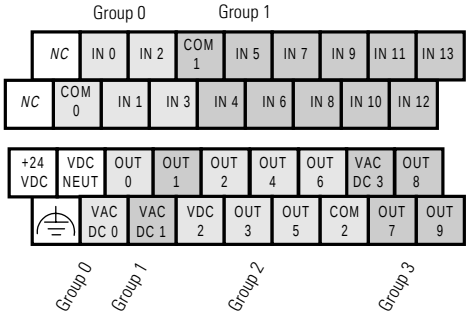


Figure 3.4 1762-L40AWA

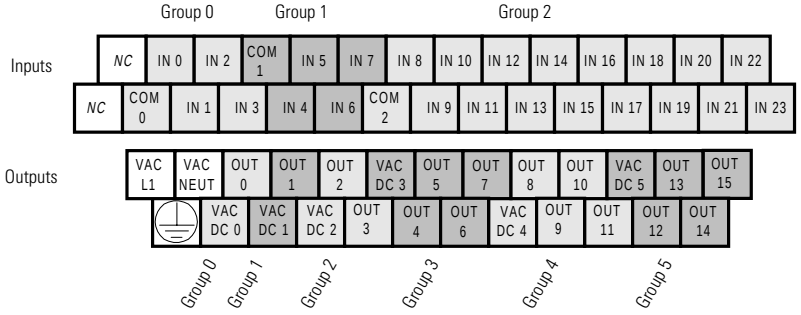
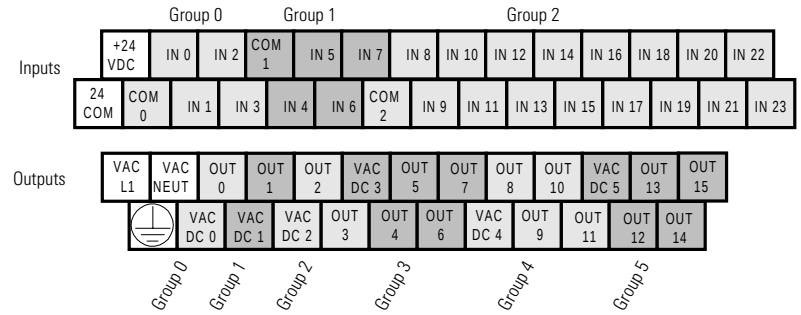


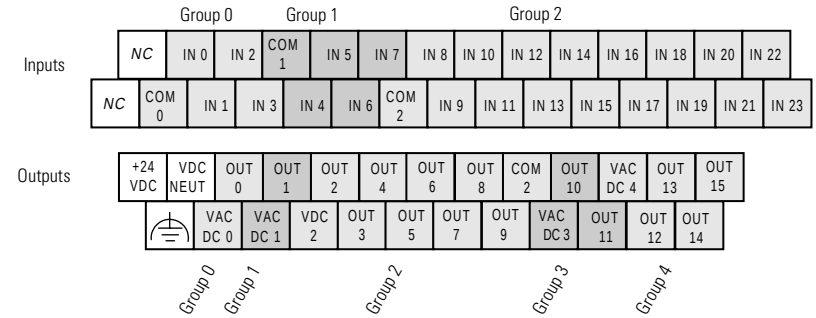
Figure 3.5 1762-L40BWA



ATTENTION

The 24V dc sensor supply of the 1762-L40BWA should not be used to power output circuits. It should only be used to power input devices (e.g. sensors, switches). See Master Control Relay on page 2-8 for information on MCR wiring in output circuits.

Figure 3.6 1762-L40BXB



Terminal Groupings

Table 3.3 Input Terminal Grouping

Controller	Inputs		
	Input Group	Common Terminal	Input Terminal
1762-L24AWA	Group 0	AC COM 0	I/0 through I/3
	Group 1	AC COM 1	I/4 through I/13
1762-L24BWA	Group 0	DC COM 0	I/0 through I/3
	Group 1	DC COM 1	I/4 through I/13
1762-L24BXB	Group 0	DC COM 0	I/0 through I/3
	Group 1	DC COM 1	I/4 through I/13
1762-L40AWA	Group 0	AC COM 0	I/0 through I/3
	Group 1	AC COM 1	I/4 through I/7
	Group 2	AC COM 2	I/8 through I/23
1762-L40BWA	Group 0	DC COM 0	I/0 through I/3
	Group 1	DC COM 1	I/4 through I/7
	Group 2	DC COM 2	I/8 through I/23
1762-L40BXB	Group 0	DC COM 0	I/0 through I/3
	Group 1	DC COM 1	I/4 through I/7
	Group 2	DC COM 2	I/8 through I/23

Table 3.4 Output Terminal Grouping

Controller	Outputs		
	Output Group	Voltage Terminal	Output Terminal
1762-L24AWA	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VAC/VDC 2	O/2 through O/3
	Group 3	VAC/VDC 3	O4 through O/5
	Group 4	VAC/VDC 4	O/6 through O/9
1762-L24BWA	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VAC/VDC 2	O/2 through O/3
	Group 3	VAC/VDC 3	O/4 through O/5
	Group 4	VAC/VDC 4	O/6 through O/9
1762-L24BXB	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VDC 2, VDC COM 2	O/2 through O/6
	Group 3	VAC/VDC 3	O/7 through O/9
1762-L40AWA	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VAC/VDC 2	O/2 through O/3
	Group 3	VAC/VDC 3	O/4 through O/7
	Group 4	VAC/VDC 4	O/8 through O/11
	Group 5	VAC/VDC 5	O/12 through O/15

Table 3.4 Output Terminal Grouping

Controller	Outputs		
	Output Group	**Voltage Terminal**	**Output Terminal**
1762-L40BWA	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VAC/VDC 2	O/2 through O/3
	Group 3	VAC/VDC 3	O/4 through O/7
	Group 4	VAC/VDC 4	O/8 through O/11
	Group 5	VAC/VDC 5	O/12 through O/15
1762-L40BXB	Group 0	VAC/VDC 0	O/0
	Group 1	VAC/VDC 1	O/1
	Group 2	VDC 2, VDC COM 2	O/2 through O/9
	Group 3	VAC/VDC 3	O/10 through O/11
	Group 4	VAC/VDC 4	O/12 through O/15

Sinking and Sourcing Wiring Diagrams

Any of the MicroLogix 1200 DC embedded input groups can be configured as sinking or sourcing depending on how the DC COM is wired on the group. Refer to pages 3-11 through 3-15 for sinking and sourcing wiring diagrams.

Type	Definition
Sinking Input	The input energizes when high-level voltage is applied to the input terminal (active high). Connect the power supply VDC (-) to the input group's COM terminal.
Sourcing Input	The input energizes when low-level voltage is applied to the input terminal (active low). Connect the power supply VDC (+) to the input group's COM terminal.

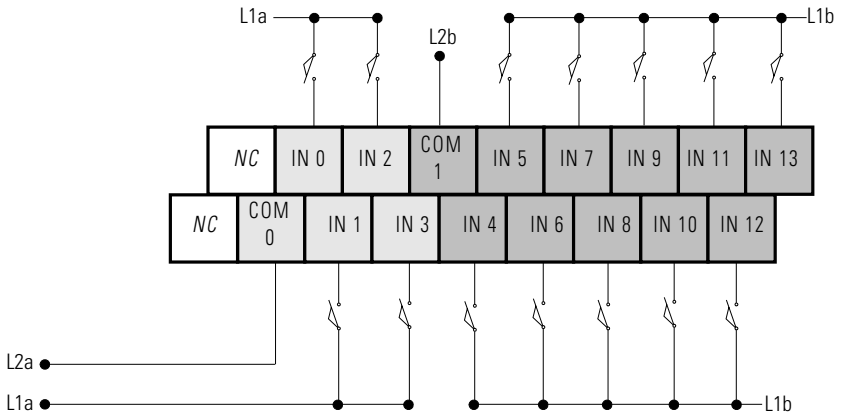
ATTENTION

The 24V dc sensor power source must not be used to power output circuits. It should only be used to power input devices (e.g. sensors, switches). See Master Control Relay on page 2-8 for information on MCR wiring in output circuits.

1762-L24AWA, 1762-L24BWA and 1762-L24BXB Wiring Diagrams

NOTE In the following diagrams, lower case alphabetic subscripts are appended to common-terminal connections to indicate that different power sources may be used for different isolated groups, if desired.

Figure 3.7 1762-L24AWA Input Wiring Diagram (1)



(1) "NC" terminals are not intended for use as connection points.

Figure 3.8 1762-L24BWA Sinking Input Wiring Diagram

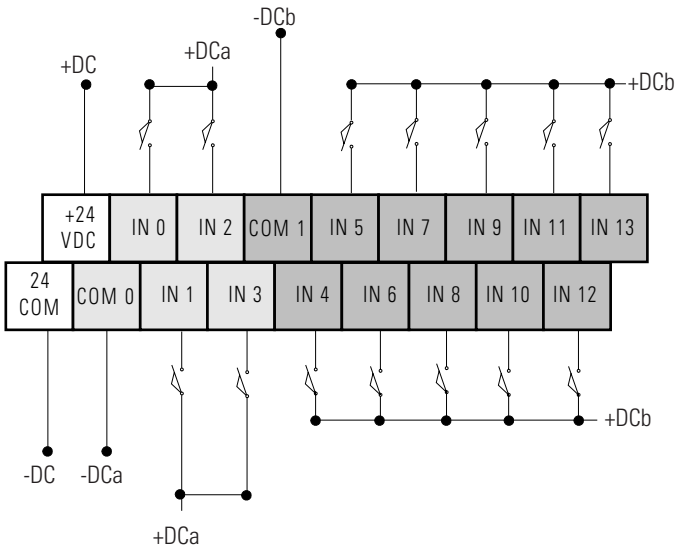


Figure 3.9 1762-L24BWA Sourcing Input Wiring Diagram

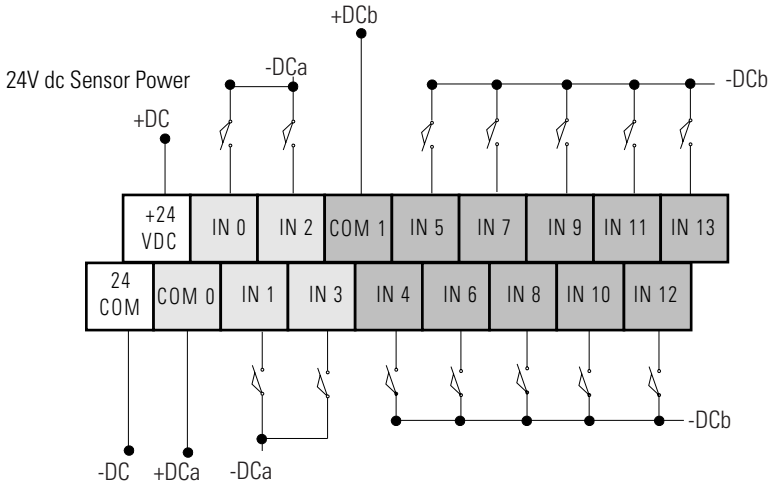


Figure 3.10 1762-L24BXB Sinking Input Wiring Diagram

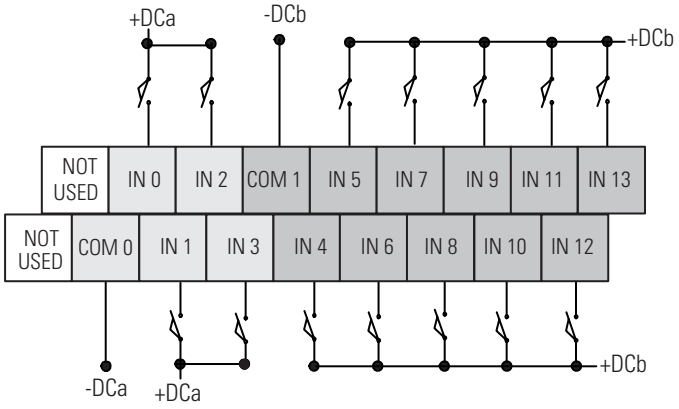


Figure 3.11 1762-L24BXB Sourcing Input Wiring Diagram

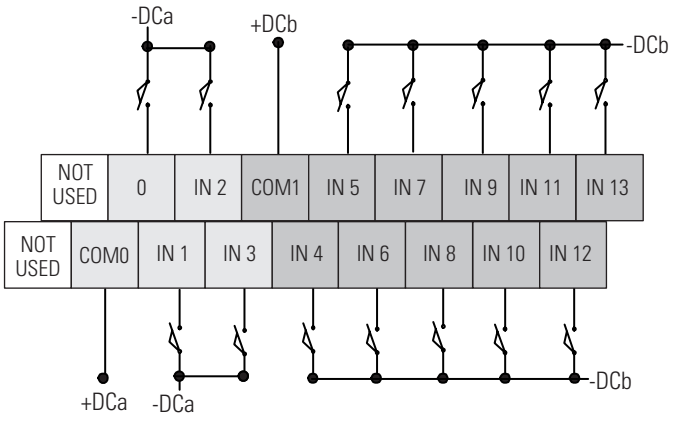


Figure 3.12 1762-L24AWA and 1762-L24BWA Output Wiring Diagram

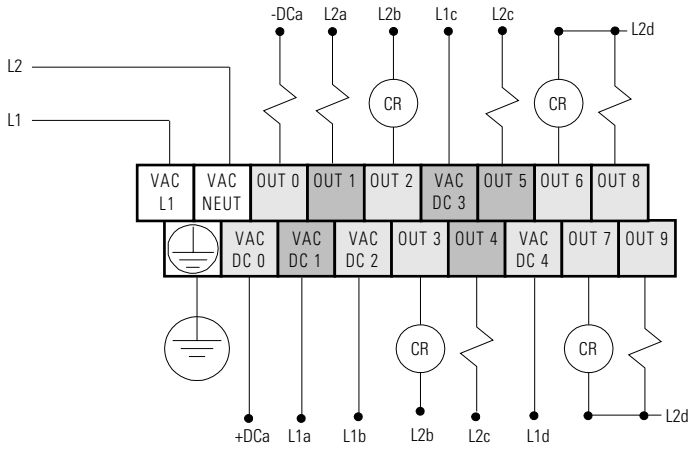
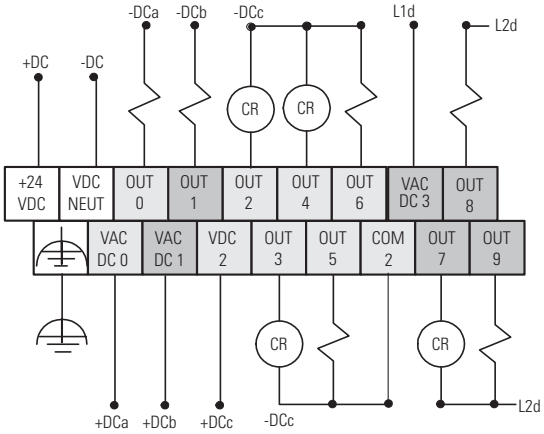


Figure 3.13 1762-L24BXB Output Wiring Diagram



1762-L40AWA, 1762-L40BWA and 1762-L40BXB Wiring Diagrams

Figure 3.14 1762-L40AWA Input Wiring Diagram

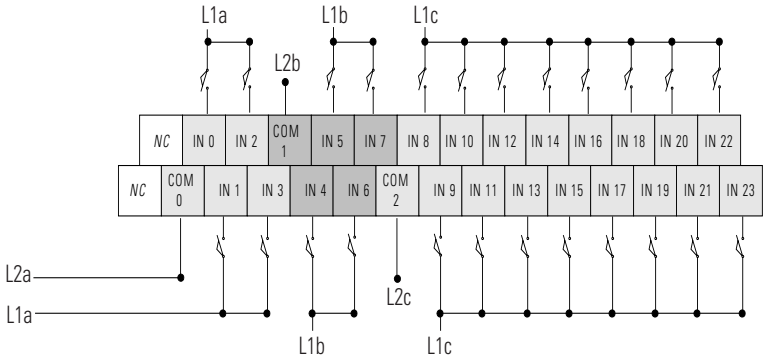


Figure 3.15 1762-L40BWA Sinking Input Wiring Diagram

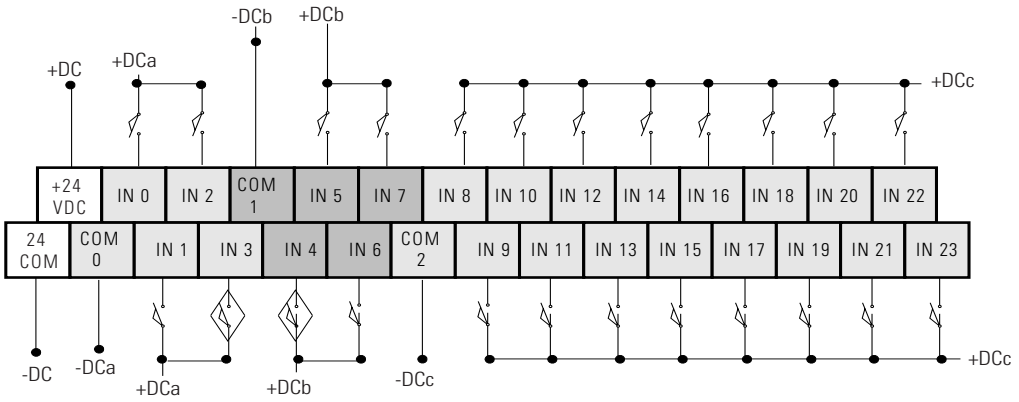


Figure 3.16 1762-L40BWA Sourcing Input Wiring Diagram

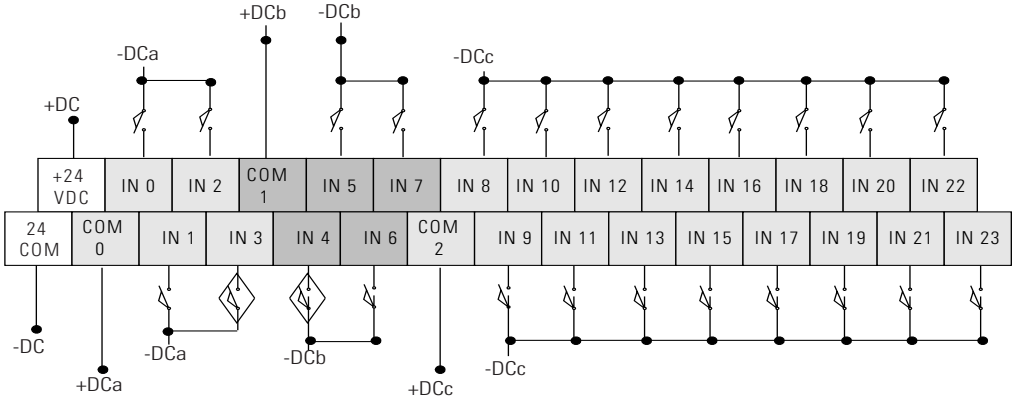


Figure 3.17 1762-L40BXB Sinking Input Wiring Diagram

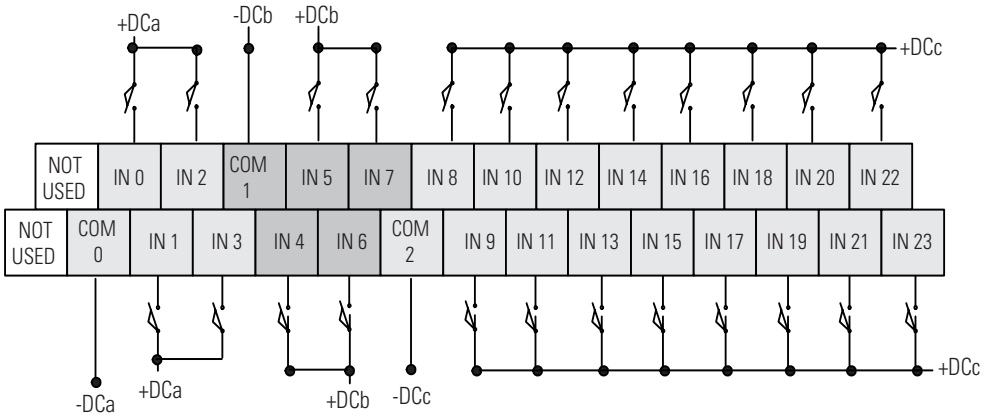


Figure 3.18 1762-L40BXB Sourcing Input Wiring Diagram

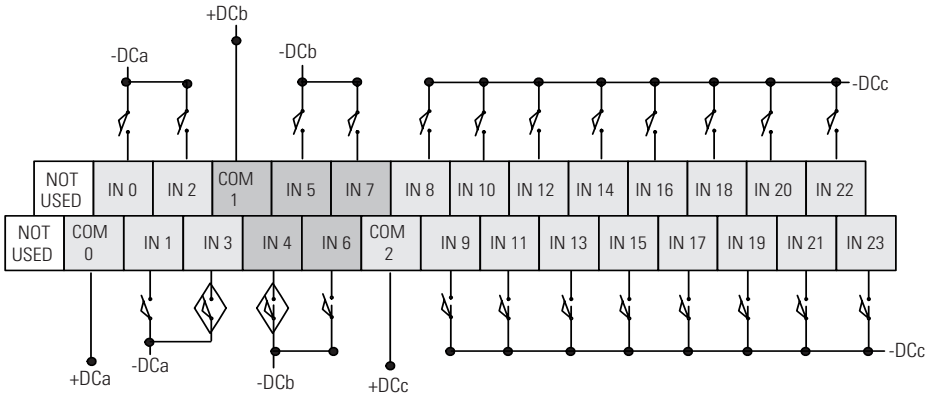


Figure 3.19 1762-L40AWA and 1762-L40BWA Output Wiring Diagram

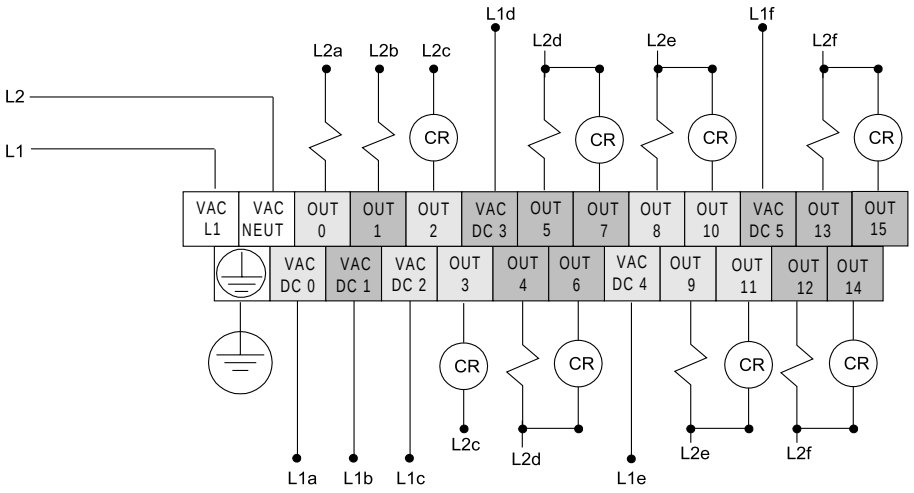
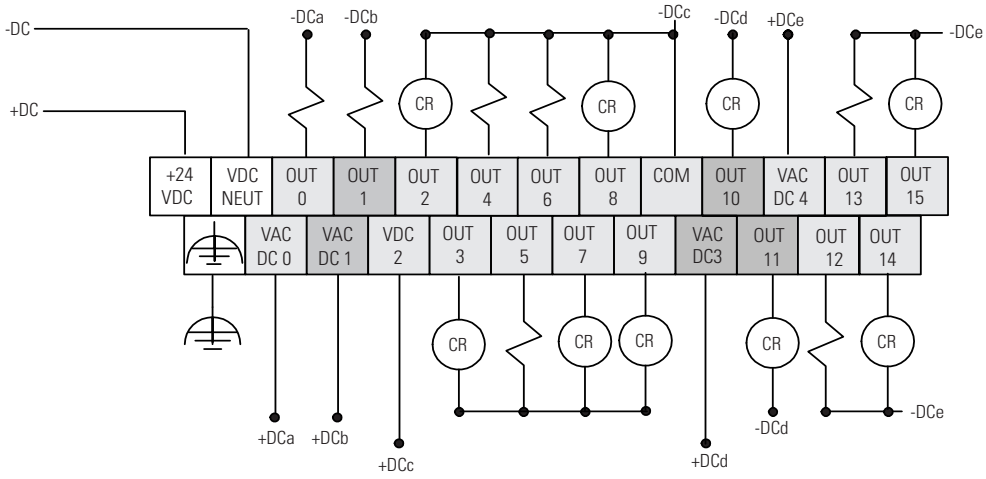


Figure 3.20 1762-L40BXB Output Wiring Diagram



Controller I/O Wiring

Minimizing Electrical Noise

Because of the variety of applications and environments where controllers are installed and operating, it is impossible to ensure that all environmental noise will be removed by input filters. To help reduce the effects of environmental noise, install the MicroLogix 1200 system in a properly rated (i.e. NEMA) enclosure. Make sure that the MicroLogix 1200 system is properly grounded.

A system may malfunction due to a change in the operating environment after a period of time. We recommend periodically checking system operation, particularly when new machinery or other noise sources are installed near the Micrologix 1200 system.

Expansion I/O Wiring

Discrete Wiring Diagrams

The following illustrations show the discrete expansion I/O wiring diagrams.

Figure 3.21 1762-IA8 Wiring Diagram

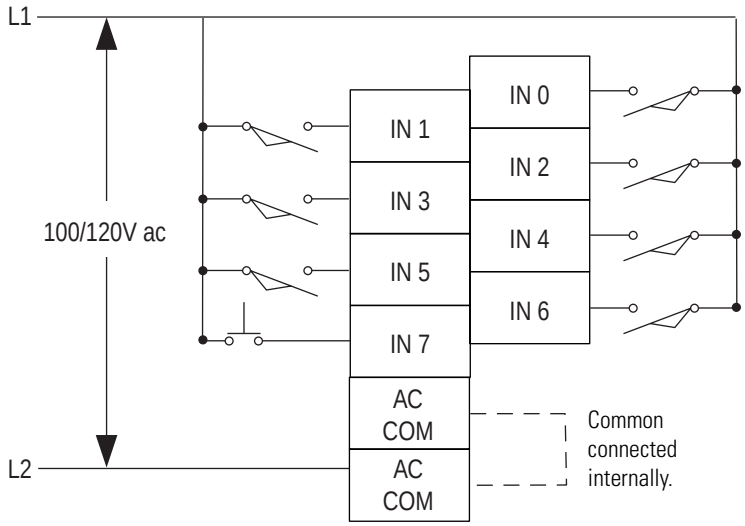


Figure 3.22 1762-IQ8 Wiring Diagram

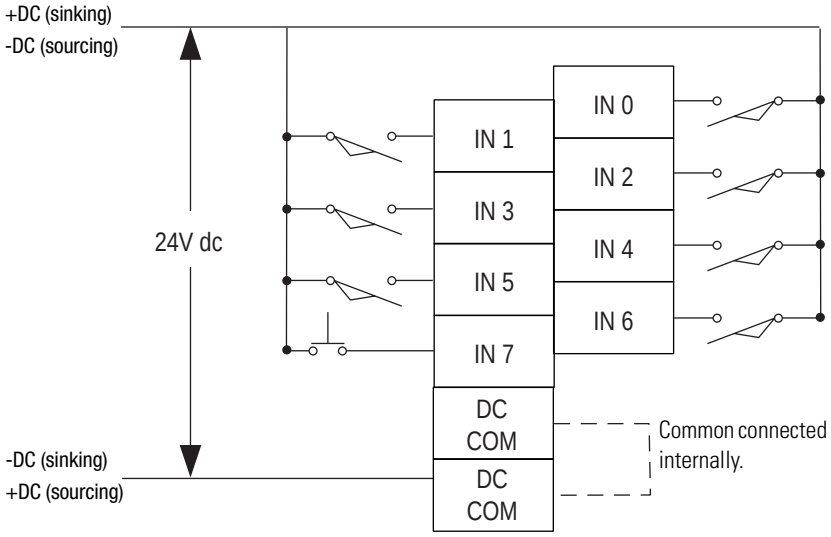


Figure 3.23 1762-IQ16 Wiring Diagram

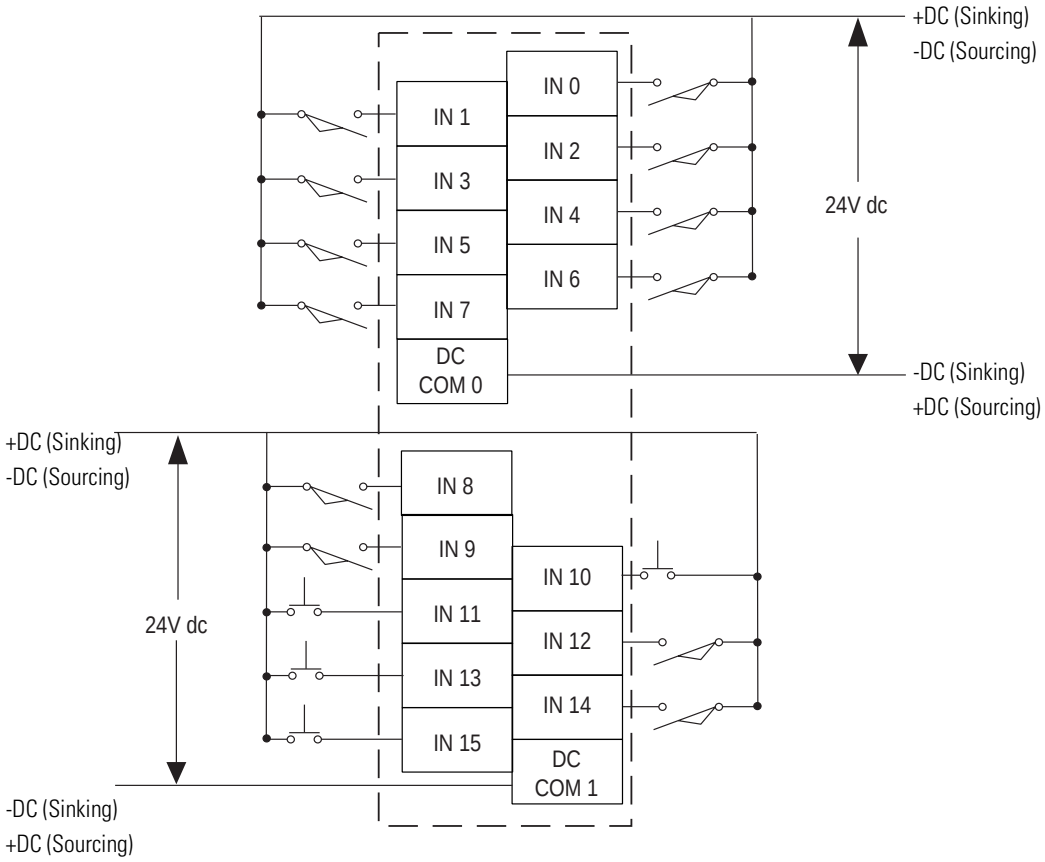


Figure 3.24 1762-OA8 Wiring Diagram

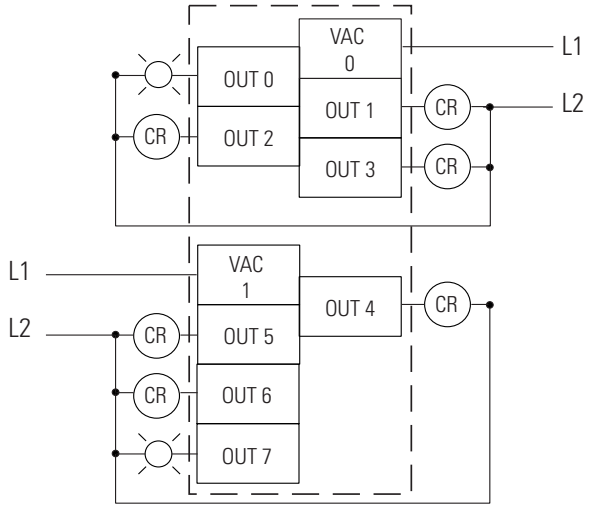


Figure 3.25 1762-OB8 Wiring Diagram

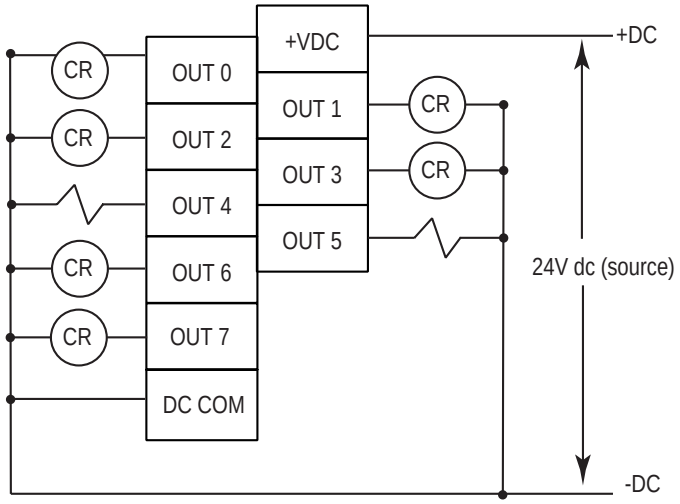


Figure 3.26 1762-OB16 Wiring Diagram

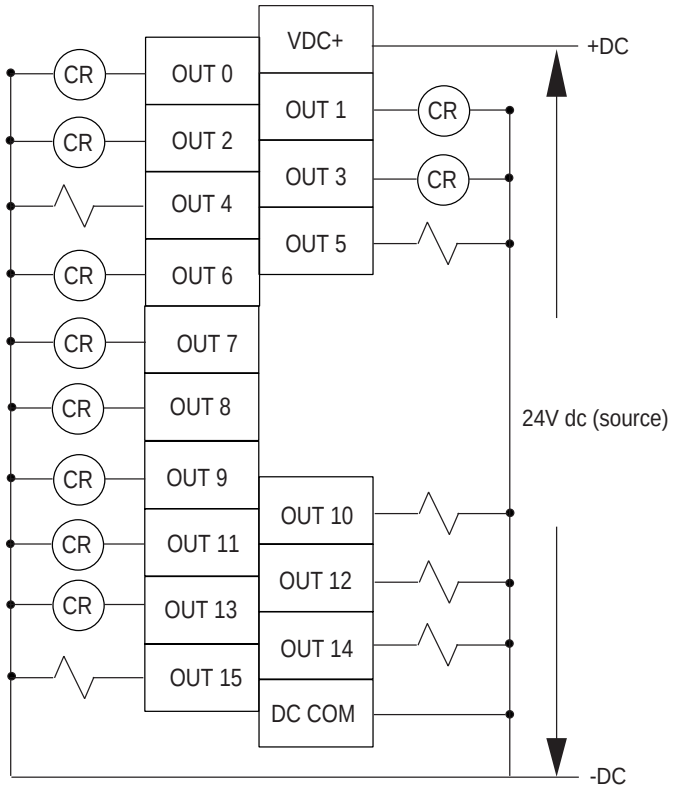


Figure 3.27 1762-OW8 Wiring Diagram

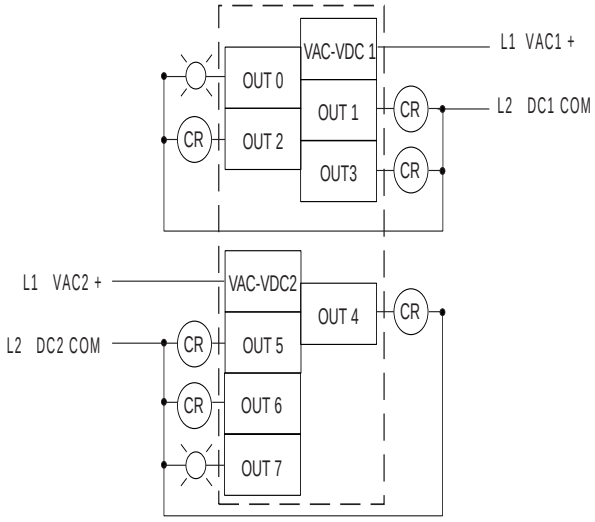
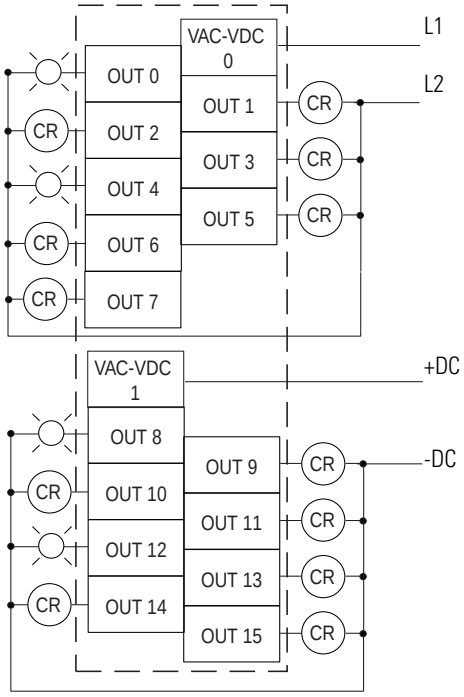


Figure 3.28 1762-OW16 Wiring Diagram



Analog Wiring

System Wiring Guidelines

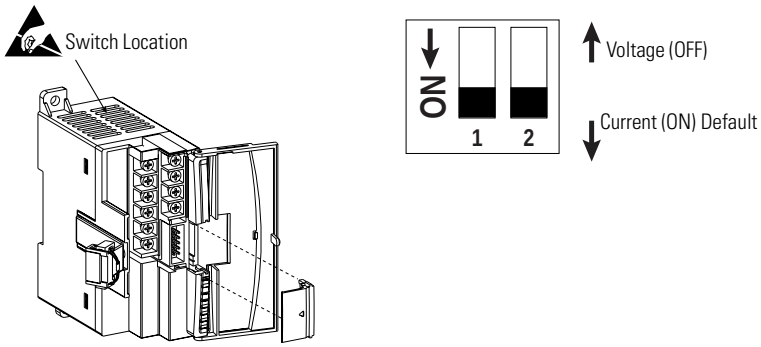
Consider the following when wiring your analog modules:

- The analog common (COM) is not connected to earth ground inside the module. All terminals are electrically isolated from the system.
- Channels are not isolated from each other.
- Use Belden™ 8761, or equivalent, shielded wire.
- Under normal conditions, the drain wire (shield) should be connected to the metal mounting panel (earth ground). Keep the shield connection to earth ground as short as possible.
- To ensure optimum accuracy for voltage type inputs, limit overall cable impedance by keeping all analog cables as short as possible. Locate the I/O system as close to your voltage type sensors or actuators as possible.
- The module does not provide loop power for analog inputs. Use a power supply that matches the input transmitter specifications.

1762-IF2OF2 Input Type Selection

Select the input type, current or voltage, using the switches located on the module's circuit board *and* the input type/range selection bits in the

Configuration Data File. Refer to *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication number 1762-RM001C-EN-P. You can access the switches through the ventilation slots on the top of the module. Switch 1 controls channel 0; switch 2 controls channel 1. The factory default setting for both switch 1 and switch 2 is Current. Switch positions are shown below.



1762-IF2OF2 Output Type Selection

The output type selection, current or voltage, is made by wiring to the appropriate terminals, Iout or Vout, *and* by the type/range selection bits in the Configuration Data File. Refer to *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication number 1762-RM001C-EN-P.

ATTENTION

Analog outputs may fluctuate for less than a second when power is applied or removed. This characteristic is common to most analog outputs. While the majority of loads will not recognize this short signal, it is recommended that preventive measures be taken to ensure that connected equipment is not affected.

1762-IF2OF2 Wiring

The following illustration shows the 1762-IF2OF2 analog expansion I/O terminal block.

Figure 3.29 1762-IF2OF2 Terminal Block Layout

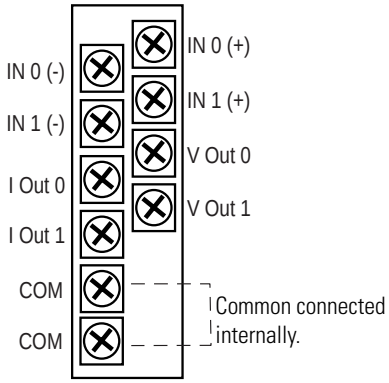


Figure 3.30 Differential Sensor Transmitter Types

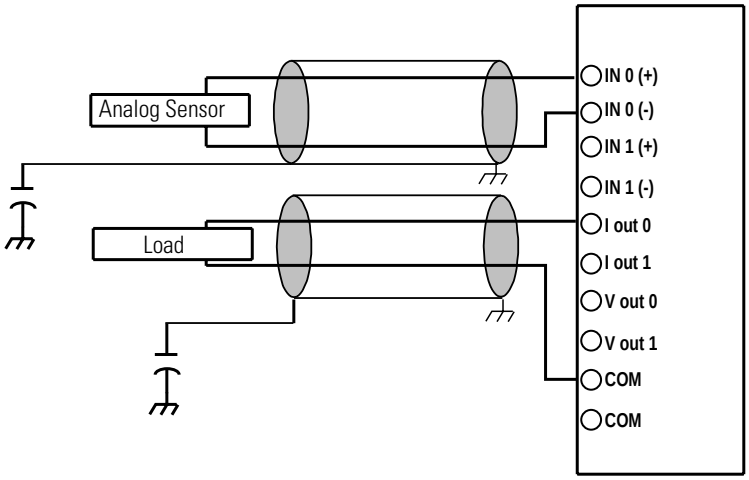
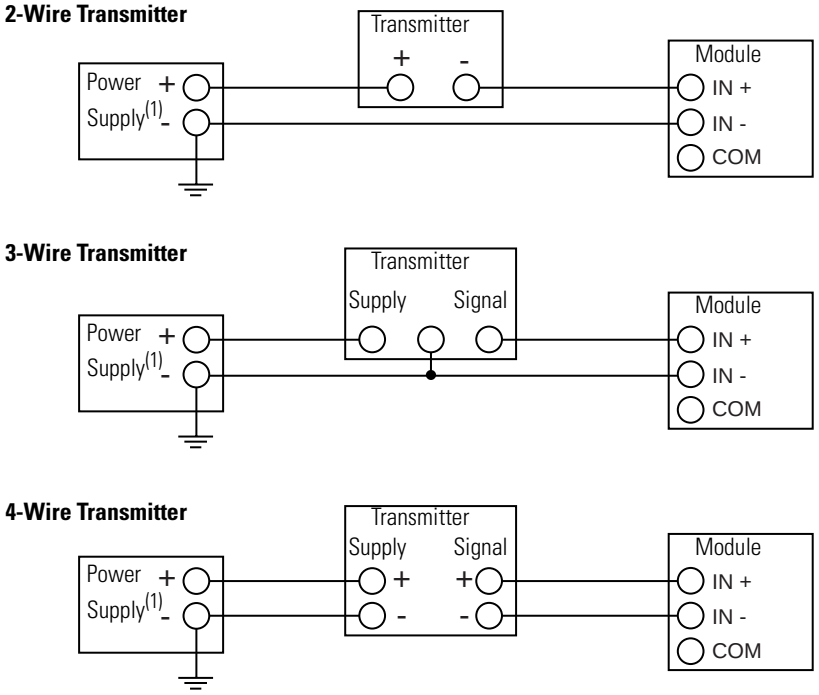


Figure 3.31 Single-ended Sensor/Transmitter Types



(1) All power supplies rated N.E.C. Class 2.

1762-IF4 Input Type Selection

Select the input type, current or voltage, using the switches located on the module's circuit board *and* the input type/range selection bits in the Configuration Data File. Refer to *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication number 1762-RM001C-EN-P. You can access the switches through the ventilation slots on the top of the module.

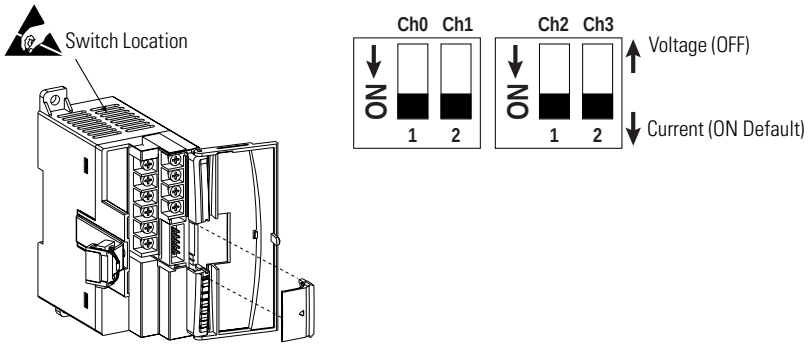


Figure 3.32 1762-IF4Terminal Block Layout

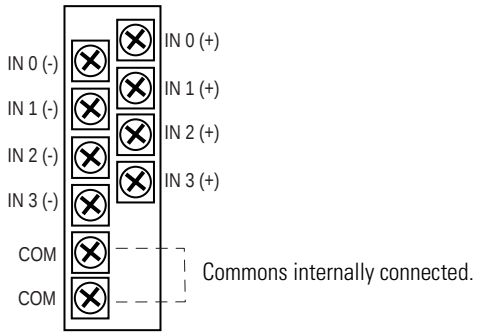
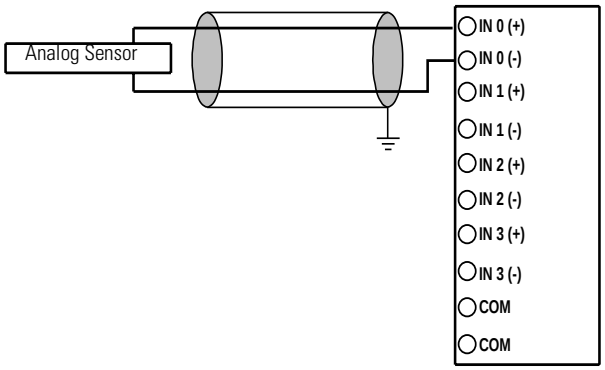
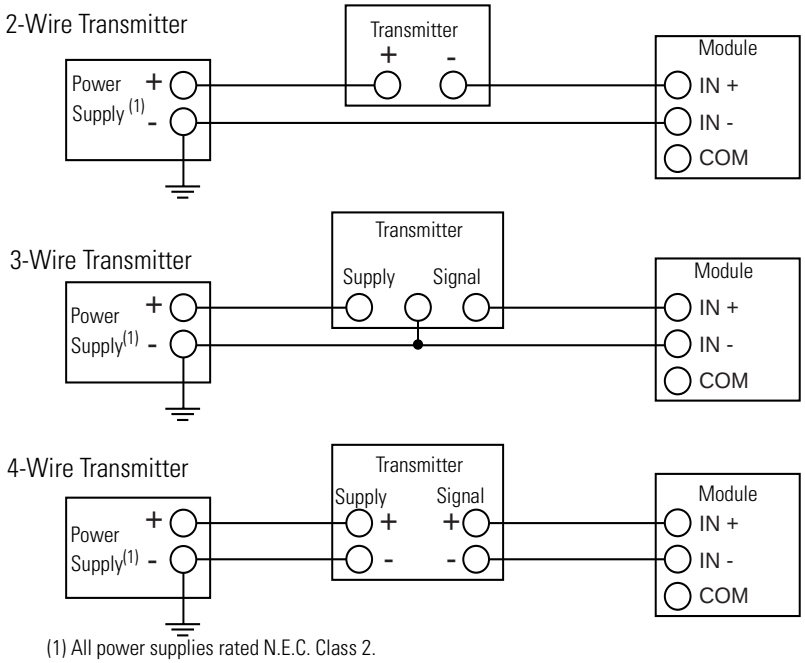


Figure 3.33 Differential Sensor Transmitter Types



NOTE Grounding the cable shield at the module end only usually provides sufficient noise immunity. However, for best cable shield performance, earth ground the shield at both ends, using a 0.01µF capacitor at one end to block AC power ground currents, if necessary.

Figure 3.34 Sensor/Transmitter Types



(1) All power supplies rated N.E.C. Class 2.

Communication Connections

This chapter describes how to communicate to your control system. The method you use and cabling required to connect your controller depends on what type of system you are employing. This chapter also describes how the controller establishes communication with the appropriate network. Topics include:

- default communication configurations
- using communications toggle push button
- connecting to RS-232 port
- connecting to DH485 network
- connecting to AIC+
- DeviceNet communications

Default Communication Configuration

The MicroLogix 1200 has the following default communication configuration.

NOTE The default configuration is present when:

- The controller is powered-up for the first time.
- The communications toggle push button specifies default communications (the DCOMM LED is on).
- An OS upgrade is completed.

See Appendix E for more information about communicating.

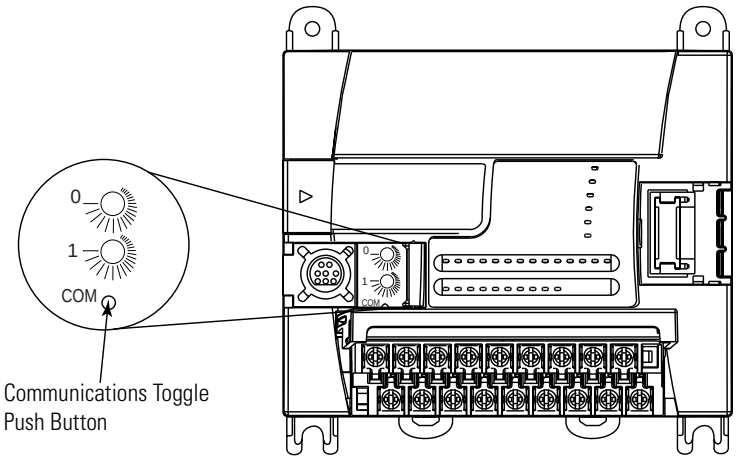
Table 4.1 DF1 Full-Duplex Default Configuration Parameters

Parameter	Default
Baud Rate	19.2K
Parity	none
Source ID (Node Address)	1
Control Line	no handshaking
Stop Bits	1

Using the Communications Toggle Push Button

The Communications Toggle Push Button is located on the processor under the processor door (if installed), as shown below.

Use the Communications Toggle Push Button to change from the user-defined communication configuration to the default communications mode and back. The Default Communications (DCOMM) LED operates to show when the controller is in the default communications mode (settings shown on page 4-1).



NOTE The Communication Toggle Push Button must be pressed and held for one second to activate.

Connecting to the RS-232 Port

There are two ways to connect the MicroLogix 1200 programmable controller to your personal computer using the DF1 protocol: using a point-to-point connection, or using a modem. Descriptions of these methods follow.

ATTENTION All devices connected to the RS-232 channel must be referenced to controller ground, or be floating (not referenced to a potential other than ground). Failure to follow this procedure may result in property damage or personal injury.

- For 1762-L24BWA and 1762-L40BWA controllers:

  The COM of the sensor supply is also connected to chassis ground internally. The 24V dc sensor power source should not be used to power output circuits. It should only be used to power input devices.

- For 1762-L24BXB and 1762-L40BXB controllers:

  The VDC NEUT or common terminal of the power supply is also connected to chassis ground internally.

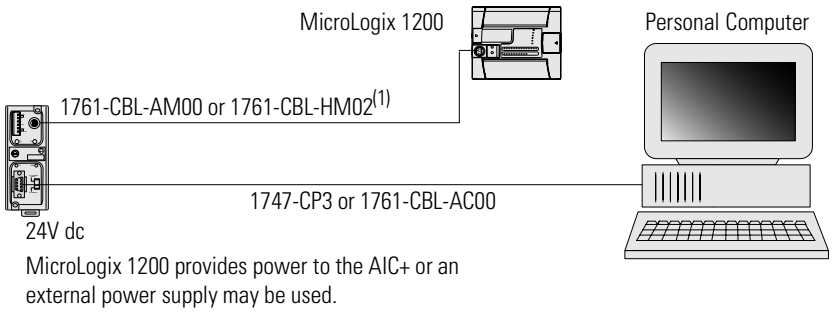
Table 4.2 Available Communication Cables

Communication Cables	Length
1761-CBL-PM02 Series C or later	2m (6.5 ft)
1761-CBL-HM02 Series C or later	2m (6.5 ft)
1761-CBL-AM00 Series C or later	45 cm (17.7 in)
1761-CBL-AP00 Series C or later	45 cm (17.7 in)
2707-NC8 Series A or later	2m (6.5 ft)
2707-NC9 Series B or later	15m (49.2 ft)
2707-NC10 Series B or later	2m (6.5 ft)
2707-NC11 Series B or later	2m (6.5 ft)

Making a DF1 Point-to-Point Connection

You can connect the MicroLogix 1200 programmable controller to your personal computer using a serial cable (1762-CBL-PM02) from your personal computer's serial port to the controller. The recommended protocol for this configuration is DF1 Full-Duplex.

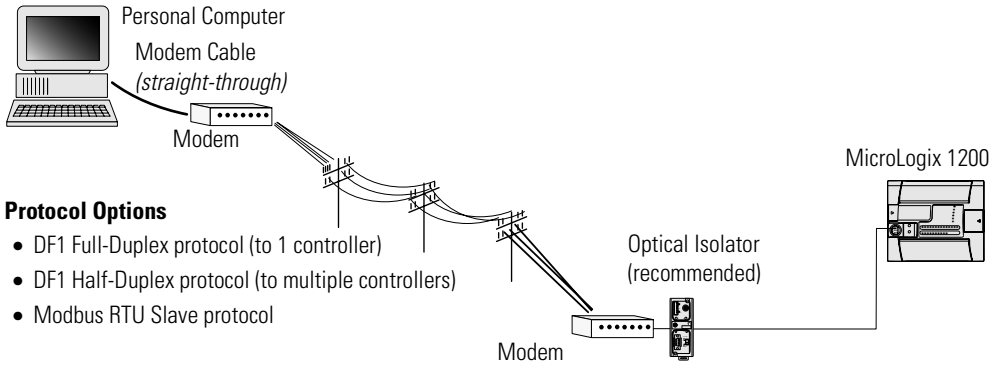
We recommend using an Advanced Interface Converter (AIC+), catalog number 1761-NET-AIC, as your optical isolator, as shown below.
See page 4-11 for specific AIC+ cabling information.


MicroLogix 1200
Personal Computer
1761-CBL-AM00 or 1761-CBL-HM02(1)
1747-CP3 or 1761-CBL-AC00
24V dc
MicroLogix 1200 provides power to the AIC+ or an external power supply may be used.

(1) Series C or higher cables are required.

Using a Modem

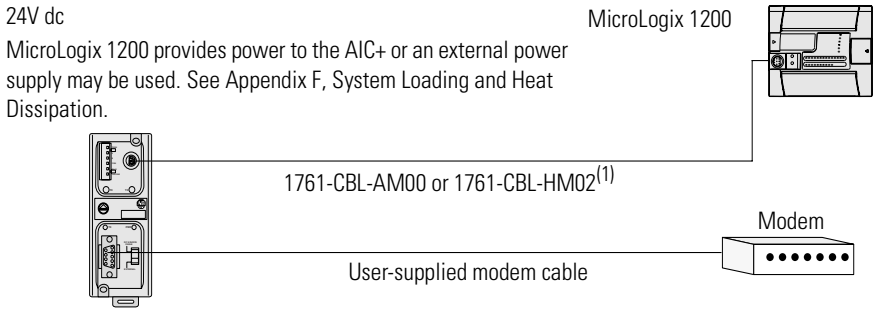
You can use modems to connect a personal computer to one MicroLogix 1200 controller (using DF1 Full-Duplex protocol) , to multiple controllers (using DF1 Half-Duplex protocol), or Modbus RTU Slave protocol, as shown in the following illustration. Do not attempt to use DH485 protocol through modems under any circumstance. (See Appendix E for information on types of modems you can use with the micro controllers.)



We recommend using an AIC+, catalog number 1761-NET-AIC, as your optical isolator. See page 4-11 for specific AIC+ cabling information.

Isolated Modem Connection

Using an AIC+ to isolate the modem is illustrated below.

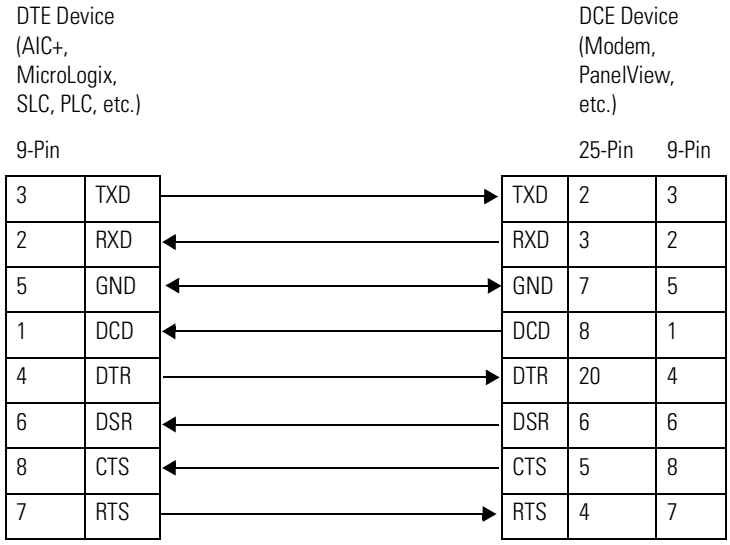

24V dc
MicroLogix 1200 provides power to the AIC+ or an external power supply may be used. See Appendix F, System Loading and Heat Dissipation.
MicroLogix 1200
1761-CBL-AM00 or 1761-CBL-HM02(1)
Modem
User-supplied modem cable

(1) Series C or higher cables are required.

For additional information on connections using the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual,* publication 1761-6.4.

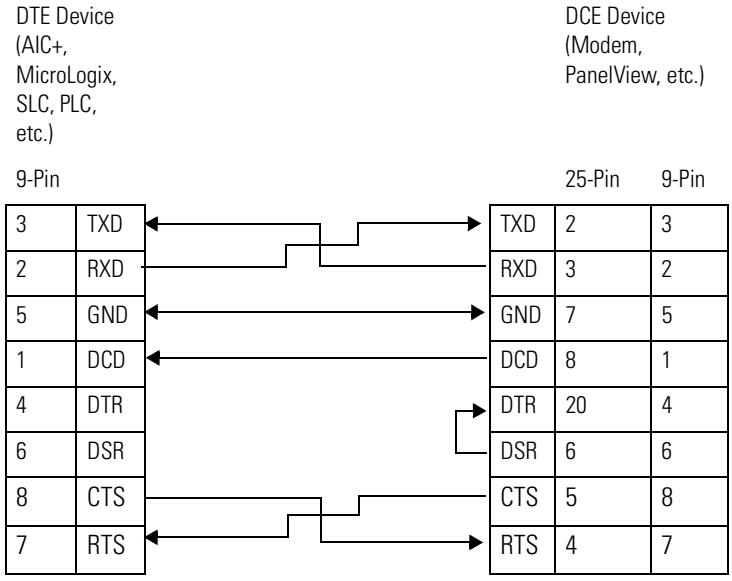
Constructing Your Own Modem Cable

If you construct your own modem cable, the maximum cable length is 15.24 m (50 ft) with a 25-pin or 9-pin connector. Refer to the following typical pinout for constructing a *straight-through* cable:



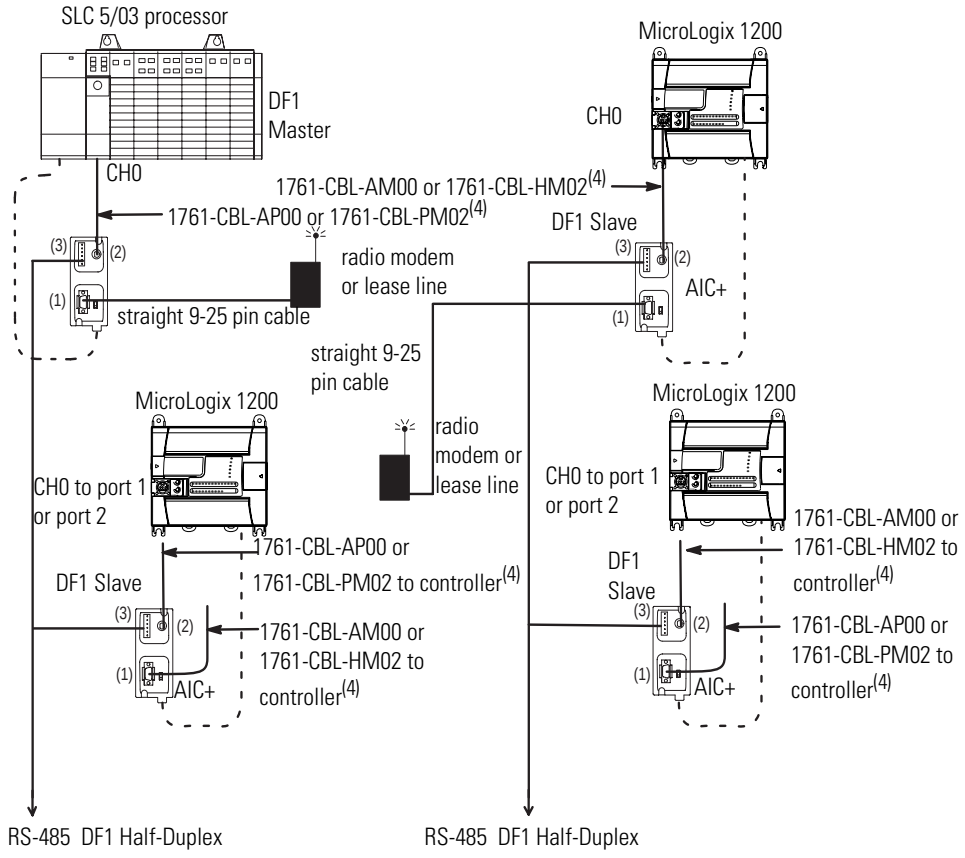
Constructing Your Own Null Modem Cable

If you construct your own null modem cable, the maximum cable length is 15.24 m (50 ft) with a 25-pin or 9-pin connector. Refer to the following typical pinout:



Connecting to a DF1 Half-Duplex Network

Use this diagram for DF1 Half-Duplex Master-Slave protocol without hardware handshaking.



(1) DB-9 RS-232 port

(2) mini-DIN 8 RS-232 port

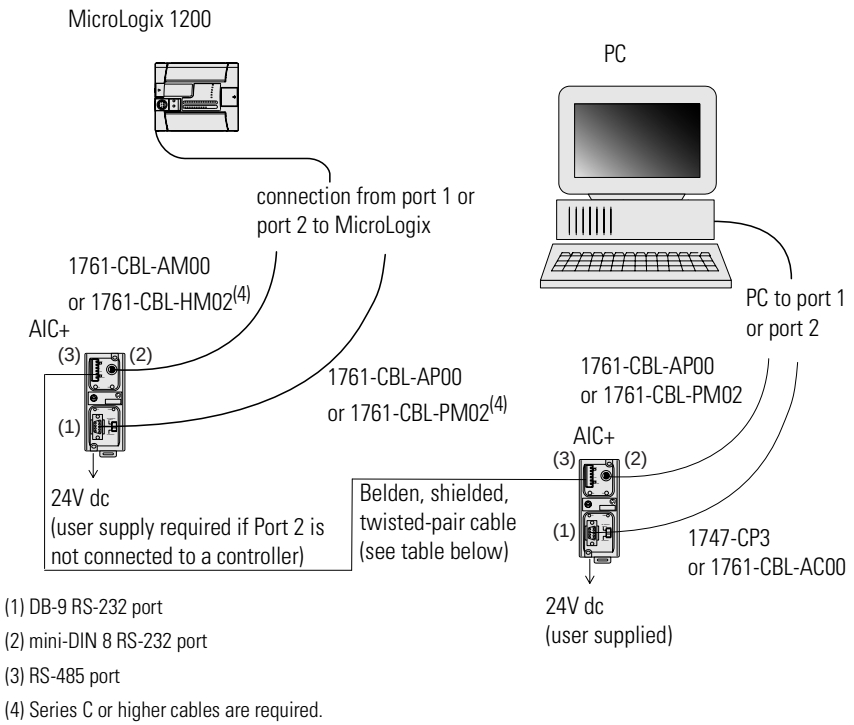
(3) RS-485 port

(4) Series C or higher cables are required.

Connecting to a DH485 Network

The following illustration shows how to connect to a DH485 network.

MicroLogix DH485 Network



(1) DB-9 RS-232 port

(2) mini-DIN 8 RS-232 port

(3) RS-485 port

(4) Series C or higher cables are required.

Recommended Tools

To connect a DH485 network, you need tools to strip the shielded cable and to attach the cable to the AIC+ Advanced Interface Converter. We recommend the following equipment (or equivalent):

Table 4.3 Working with Cable for DH485 Network

Description	Part Number	Manufacturer
Shielded Twisted Pair Cable	#3106A or #9842	Belden
Stripping Tool	45-164	Ideal Industries
1/8" Slotted Screwdriver	Not Applicable	Not Applicable

DH485 Communication Cable

The suggested DH485 communication cable is either Belden #3106A or #9842. The cable is jacketed and shielded with one or two twisted-wire pairs and a drain wire.

One pair provides a balanced signal line and one additional wire is used for a common reference line between all nodes on the network. The shield reduces the effect of electrostatic noise from the industrial environment on network communication.

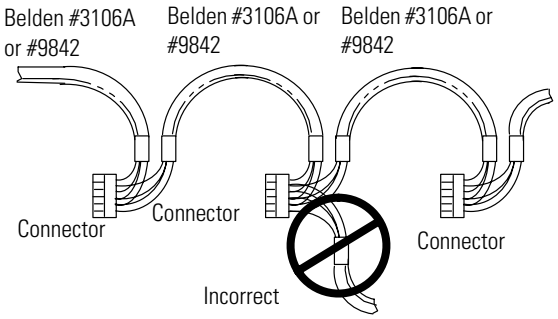
The communication cable consists of a number of cable segments daisy-chained together. The total length of the cable segments cannot exceed 1219 m (4000 ft). However, two segments can be used to extend the DH485 network to 2438 m (8000 ft). For additional information on connections using the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual,* publication 1761-6.4.

When cutting cable segments, make them long enough to route them from one AIC+ to the next, with sufficient slack to prevent strain on the connector. Allow enough extra cable to prevent chafing and kinking in the cable.

Use these instructions for wiring the Belden #3106A or #9842 cable. (See Cable Selection Guide on page 4-11 if you are using standard Allen-Bradley cables.)

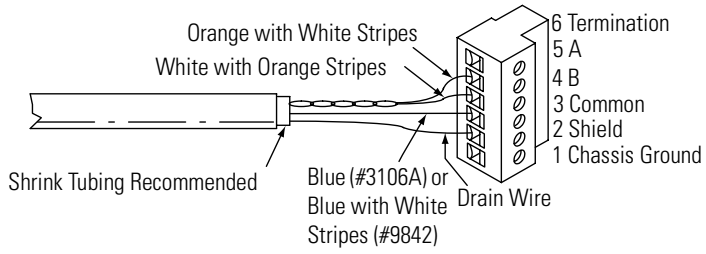
Connecting the Communication Cable to the DH485 Connector

NOTE A daisy-chained network is recommended. Do *not* make the incorrect connection shown below:



Single Cable Connection

When connecting a single cable to the DH485 connector, use the following diagram.



Multiple Cable Connection

When connecting multiple cables to the DH485 connector, use the following diagram.

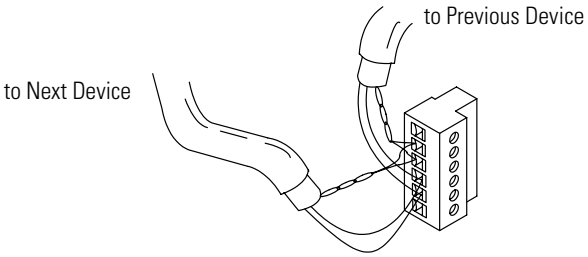


Table 4.4 Connections using Belden #3106A Cable

For this Wire/Pair	Connect this Wire	To this Terminal
Shield/Drain	Non-jacketed	Terminal 2 - Shield
Blue	Blue	Terminal 3 - (Common)
White/Orange	White with Orange Stripe	Terminal 4 - (Data B)
	Orange with White Stripe	Terminal 5 - (Data A)

Table 4.5 Connections using Belden #9842 Cable

For this Wire/Pair	Connect this Wire	To this Terminal
Shield/Drain	Non-jacketed	Terminal 2 - Shield
Blue/White	White with Blue Stripe	Cut back - no connection(1)
	Blue with White Stripe	Terminal 3 - (Common)
White/Orange	White with Orange Stripe	Terminal 4 - (Data B)
	Orange with White Stripe	Terminal 5 - (Data A)

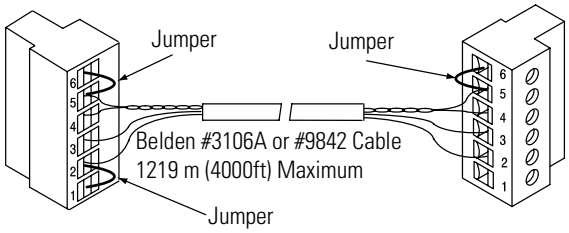
(1) To prevent confusion when installing the communication cable, cut back the white with blue stripe wire immediately after the insulation jacket is removed. This wire is not used by DH485.

Grounding and Terminating the DH485 Network

Only one connector at the end of the link must have Terminals 1 and 2 jumpered together. This provides an earth ground connection for the shield of the communication cable.

Both ends of the network must have Terminals 5 and 6 jumpered together, as shown below. This connects the termination impedance (of 120 ohm) that is built into each AIC+ as required by the DH485 specification.

End-of-Line Termination



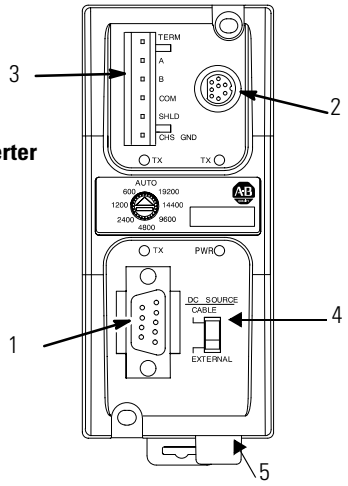
Connecting the AIC+

The AIC+, catalog number 1761-NET-AIC, enables a MicroLogix 1200 to connect to a DH485 network. The AIC+ has two RS-232 ports and one isolated RS-485 port. Typically, there is one AIC+ for each MicroLogix 1200. When two MicroLogix controllers are closely positioned, you can connect a controller to each of the RS-232 ports on the AIC+.

The AIC+ can also be used as an RS-232 isolator, providing an isolation barrier between the MicroLogix 1200 communications port and any equipment connected to it (i.e. personal computer, modem, etc.).

The following figure shows the external wiring connections and specifications of the AIC+.

AIC+ Advanced Interface Converter (1761-NET-AIC)



Item	Description
1	Port 1 - DB-9 RS-232, DTE
2	Port 2 - mini-DIN 8 RS-232 DTE
3	Port 3 - RS-485 Phoenix plug
4	DC Power Source selector switch (cable = port 2 power source, external = external power source connected to item 5)
5	Terminals for external 24V dc power supply and chassis ground

For additional information on connecting the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual,* publication 1761-6.4.

Cable Selection Guide

1761-CBL-AP00(2)

1761-CBL-PM02 (2)

Cable	Length	Connections from	to AIC+	External Power Supply Required(1)	Power Selection Switch Setting(1)
1761-CBL-AP00(2) 1761-CBL-PM02(2)	45 cm (17.7 in) 2m (6.5 ft)	SLC 5/03 or SLC 5/04 processors, ch 0	port 2	yes	external
		MicroLogix 1000, 1200, or 1500	port 1	yes	external
		PanelView 550 through NULL modem adapter	port 2	yes	external
		DTAM Plus / DTAM Micro	port 2	yes	external
		PC COM port	port 2	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

(2) Series C or higher cables are required.

Cable	Length	Connections from	to AIC+	External Power Supply Required(1)	Power Selection Switch Setting
1761-CBL-AM00(2) 1761-CBL-HM02(2)	45 cm (17.7 in) 2m (6.5 ft)	MicroLogix 1000, 1200, or 1500	port 2	no	cable
		to port 2 on another AIC+	port 2	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

(2) Series C or higher cables are required.

Cable	Length	Connections from	to AIC+	External Power Supply Required(1)	Power Selection Switch Setting(1)
1747-CP3 1761-CBL-AC00(1)	3m (9.8 ft) 45 cm (17.7 in)	SLC 5/03 or SLC 5/04 processor, channel 0	port 1	yes	external
		PC COM port	port 1	yes	external
		PanelView 550 through NULL modem adapter	port 1	yes	external
		DTAM Plus / DTAM Micro™	port 1	yes	external
		Port 1 on another AIC+	port 1	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

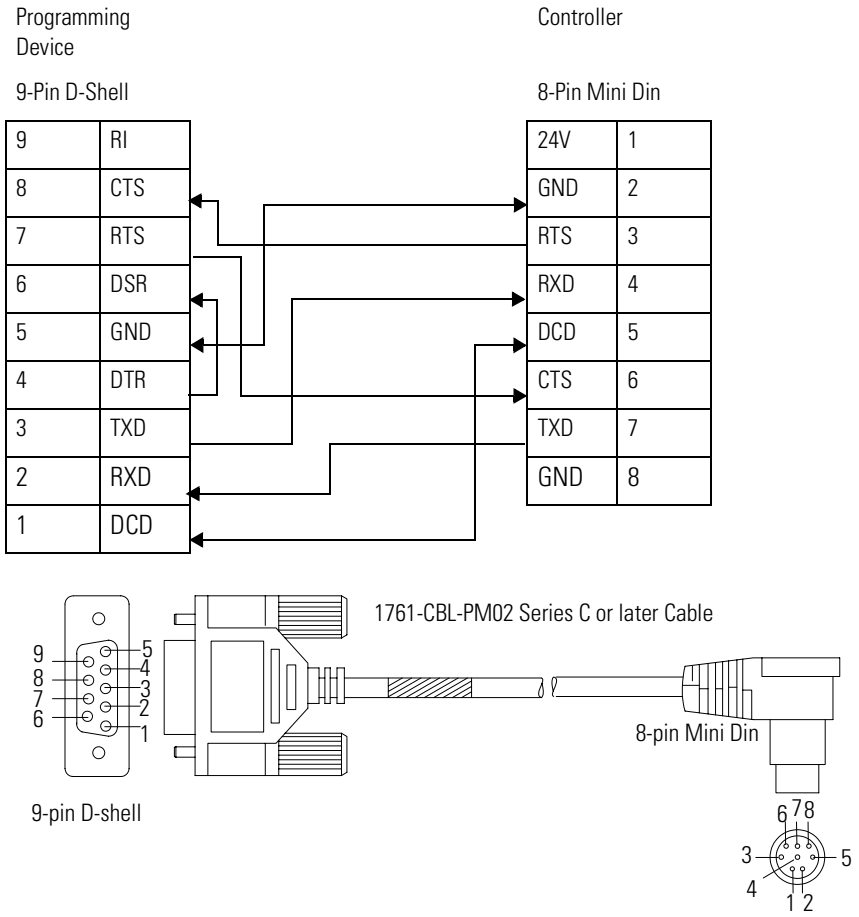
Cable	Length	Connections from	to AIC+	External Power Supply Required(1)	Power Selection Switch Setting(1)
straight 9-25 pin	—	modem or other communication device	port 1	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

Cable	Length	Connections from	to AIC+	External Power Supply Required(1)	Power Selection Switch Setting(1)
1761-CBL-AS03 1761-CBL-AS09	3m (9.8 ft) 9.5m (31.17 ft)	SLC 500 Fixed, SLC 5/01, SLC 5/02, and SLC 5/03 processors	port 3	yes	external
		PanelView 550 RJ45 port	port 3	yes	external

(1) External power supply required unless the AIC+ is powered by the device connected to port 2, then the selection switch should be set to *cable*.

1761-CBL-PM02 Series C (or equivalent) Cable Wiring Diagram



Recommended User-Supplied Components

These components can be purchased from your local electronics supplier.

Table 4.6 User Supplied Components

Component	Recommended Model
external power supply and chassis ground	power supply rated for 20.4 to 28.8V dc
NULL modem adapter	standard AT
straight 9-25 pin RS-232 cable	see table below for port information if making own cables

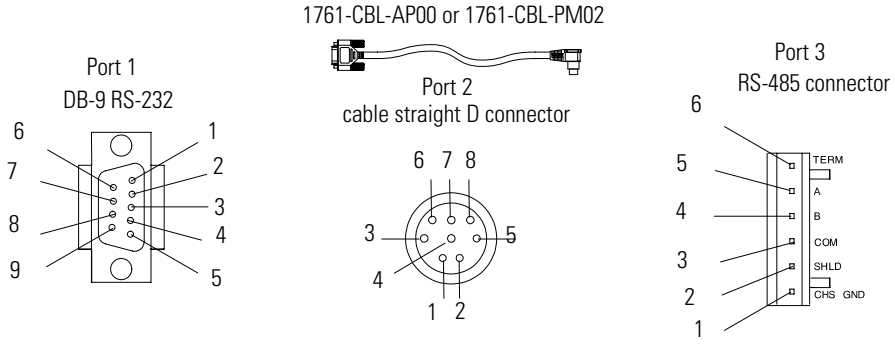


Table 4.7 AIC+ Terminals

Pin	Port 1: DB-9 RS-232	Port 2[2]: (1761-CBL-PM02 cable)	Port 3: RS-485 Connector
1	received line signal detector (DCD)	24V dc	chassis ground
2	received data (RxD)	ground (GND)	cable shield
3	transmitted data (TxD)	request to send (RTS)	signal ground
4	DTE ready (DTR)[1]	received data (RxD)[3]	DH485 data B
5	signal common (GND)	received line signal detector (DCD)	DH485 data A
6	DCE ready (DSR)[1]	clear to send (CTS)[3]	termination
7	request to send (RTS)	transmitted data (TxD)	not applicable
8	clear to send (CTS)	ground (GND)	not applicable
9	not applicable	not applicable	not applicable

(1) On port 1, pin 4 is electronically jumpered to pin 6. Whenever the AIC+ is powered on, pin 4 will match the state of pin 6.

(2) An 8-pin mini DIN connector is used for making connections to port 2. This connector is not commercially available. If you are making a cable to connect to port 2, you must configure your cable to connect to the Allen-Bradley cable shown above.

(3) In the 1761-CBL-PM02 cable, pins 4 and 6 are jumpered together within the DB-9 connector.

Safety Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only.

WARNING

EXPLOSION HAZARD - AIC+ must be operated from an external power source.

This product must be installed in an enclosure. All cables connected to the product must remain in the enclosure or be protected by conduit or other means.

See Safety Considerations on page 2-4 for additional information.

Installing and Attaching the AIC+

1. Take care when installing the AIC+ in an enclosure so that the cable connecting the MicroLogix 1200 controller to the AIC+ does not interfere with the enclosure door.
2. Carefully plug the terminal block into the RS-485 port on the AIC+ you are putting on the network. Allow enough cable slack to prevent stress on the plug.
3. Provide strain relief for the Belden cable after it is wired to the terminal block. This guards against breakage of the Belden cable wires.

Powering the AIC+

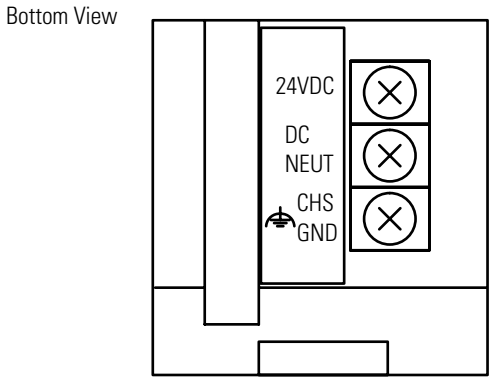
In normal operation with the MicroLogix 1200 programmable controller connected to port 2 of the AIC+, the controller powers the AIC+. Any AIC+ not connected to a controller requires a 24V dc power supply. The AIC+ requires 120 mA at 24V dc.

If both the controller and external power are connected to the AIC+, the power selection switch determines what device powers the AIC+.

ATTENTION

If you use an external power supply, it must be 24V dc (-15%/+20%). Permanent damage results if a higher voltage supply is used.

Set the DC Power Source selector switch to EXTERNAL before connecting the power supply to the AIC+. The following illustration shows where to connect external power for the AIC+.



ATTENTION

Always connect the CHS GND (chassis ground) terminal to the nearest earth ground. This connection must be made whether or not an external 24V dc supply is used.

Power Options

Below are two options for powering the AIC+:

- Use the 24V dc user power supply built into the MicroLogix 1200 controller. The AIC+ is powered through a hard-wired connection using a communication cable (1761-CBL-HM02, or equivalent) connected to port 2.
- Use an external DC power supply with the following specifications:
  - operating voltage: 24V dc (-15%/+20%)
  - output current: 150 mA minimum
  - rated NEC Class 2

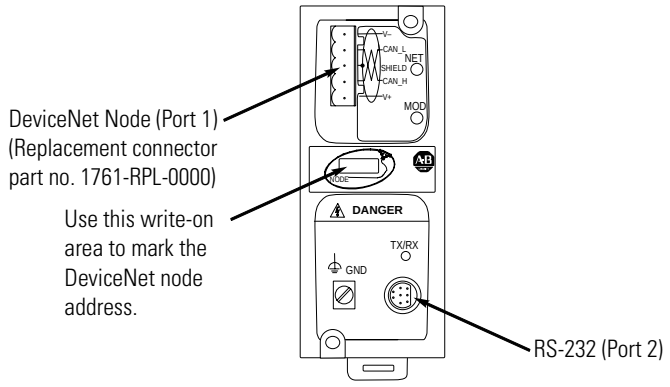
Make a hard-wired connection from the external supply to the screw terminals on the bottom of the AIC+.

ATTENTION

If you use an external power supply, it must be 24V dc (-15%/+20%). Permanent damage results if miswired with the wrong power source.

DeviceNet Communications

You can connect a MicroLogix 1200 to a DeviceNet network using the DeviceNet Interface (DNI), catalog number 1761-NET-DNI. For additional information on using the DNI, refer to the *DeviceNet Interface User Manual*, publication 1761-6.5. The following figure shows the external wiring connections of the DNI.



Cable Selection Guide(1)

Cable	Length	Connections from	to DNI
1761-CBL-AM00 1761-CBL-HM02	45 cm (17.7 in) 2m (6.5 ft)	MicroLogix 1000	port 2
		MicroLogix 1200	port 2

Cable	Length	Connections from	to DNI
1761-CBL-AP00 1761-CBL-PM02	45 cm (17.7 in) 2m (6.5 ft)	SLC 5/03 or SLC 5/04 processors, channel 0	port 2
		PC COM port	port 2

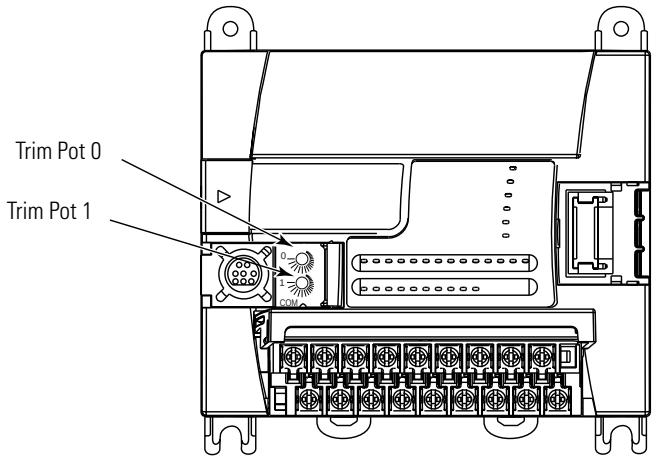
(1) Series C (or higher) cables are required.

Using Trim Pots

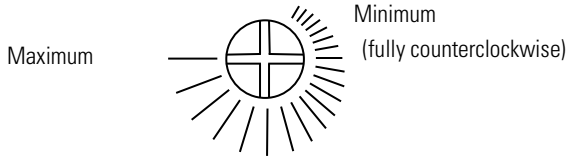
Trim Pot Operation

The processor has two trimming potentiometers (trim pots) which allow modification of data within the controller. Adjustments to the trim pots change the value in the corresponding Trim Pot Information (TPI) register. The data value of each trim pot can be used throughout the control program as timer, counter, or analog presets depending upon the requirements of the application.

The trim pots are located below the memory module port cover and to the right of the communications port, as shown below.



Use a small flathead screwdriver to turn the trim pots. Adjusting their value causes data to change within a range of 0 to 250 (fully clockwise). The maximum rotation of each trim pot is three-quarters, as shown below. Trim pot stability over time and temperature is typically ±2 counts.



Trim pot file data is updated continuously whenever the controller is powered-up.

Trim Pot Information Function File

The composition of the Trim Pot Information (TPI) Function File is described in the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001C-EN-P.

Error Conditions

Error conditions of the TPI Function File are described in the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001C-EN-P.

Using Real-Time Clock and Memory Modules

NOTE For more information on "Real-Time Clock Function File" and "Memory Module Information File" refer to the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001C-EN-P.

Three modules with different levels of functionality are available for use with the MicroLogix 1200 controller.

Catalog Number	Function
1762-RTC	Real-Time Clock
1762-MM1	Memory Module
1762-MM1RTC	Memory Module and Real-Time Clock

Real-Time Clock Operation

Removal/Insertion Under Power

At power-up and when the controller enters a run or test mode, the controller determines if a real-time clock module (RTC) is present. If an RTC is present, its values (date, time and status) are written to the RTC Function File in the controller.

The RTC module can be installed or removed at any time without risk of damage to either the module or the controller. If an RTC is installed while the MicroLogix 1200 is in a run or test mode, the module is not recognized until either a power cycle occurs or until the controller is placed in a non-executing mode (program mode, suspend mode or fault condition).

Removal of the RTC during run mode is detected within one program scan. Removal of the RTC while in run mode causes the controller to write zeros to the RTC Function File.

The following table indicates the accuracy of the RTC for various temperatures.

Table 6.1 RTC Accuracy

Ambient Temperature	Accuracy[1]
0°C (+32°F)	+34 to -70 seconds/month
+25°C (+77°F)	+36 to -68 seconds/month
+40°C (+104°F)	+29 to -75 seconds/month
+55°C (+131°F)	-133 to -237 seconds/month

(1) These numbers are maximum worst case values over a 31-day month.

Writing Data to the Real-Time Clock

When valid data is sent to the real-time clock from the programming device or another controller, the new values take effect immediately.

The real-time clock does not recognize or accept invalid date or time data.

Use the *Disable Clock* button in your RSLogix programming software to disable the real-time clock before storing a module. This decreases the drain on the RTC battery during storage.

RTC Battery Operation

The real-time clock has an internal battery that is not replaceable. The RTC Function File features a battery low indicator bit (RTC:0/BL), which shows the status of the RTC battery. When the battery is low, the indicator bit is set (1). This means that the battery may fail within 14 days and the real-time clock module needs to be replaced. When the battery low indicator bit is clear (0), the battery level is acceptable or a real-time clock is not attached.

If the RTC battery is low and the controller is powered, the RTC operates normally. If the controller power is removed and the RTC battery is low, RTC data is lost.

Life Span	Operating Temperature	Storage Temperature[1]
5 years	+0°C to +40°C (+32°F to +104°F)	-40°C to +60°C (-40°F to +140°F)

(1) Stored for six months.

ATTENTION

Operating with a low battery indication for more than 14 days may result in invalid RTC data unless power is on continuously.

Memory Module Operation

The memory module supports the following features:

- User Program and Data Back-up
- User Program Compare
- Data File Download Protection
- Memory Module Write Protection
- Removal/Insertion Under Power

ATTENTION

Electrostatic discharge can damage the Memory Module. Do not touch the connector pins or other sensitive areas.

User Program and Data Back-up

The memory module provides a simple and flexible program/data transport mechanism, allowing the user to transfer the program and data to the controller without the use of a personal computer and programming software.

The memory module can store one user program at a time.

During program transfers to or from the memory module, the controller's RUN LED flashes.

Program Compare

The memory module can also provide application security, allowing you to specify that if the program stored in the memory module does not match the program in the controller, the controller will not enter an executing (run or test) mode. To enable this feature, set the S:2/9 bit in the system status file. See "Status System File" in the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, Publication 1762-RM001C-EN-P for more information.

Data File Download Protection

The memory module supports data file download protection. This allows user data to be saved (not overwritten) during a download.

NOTE Data file download protection is only functional if the processor does not have a fault, size of all protected data files in the memory module exactly match the size of protected data files within the controller, and all protected data files are of the same type. See "Protecting Data Files During Download" in the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, Publication 1762-RM001C-EN-P.

Memory Module Write Protection

The memory module supports write-once, read-many behavior. Write protection is enabled using your programming software.

IMPORTANT Once set, write protection cannot be removed. A change cannot be made to the control program stored in a write protected memory module. If a change is required, use a different memory module.

Removal/Insertion Under Power

The memory module can be installed or removed at any time without risk of damage to either the memory module or the controller. If a memory module is installed while the MicroLogix 1200 is executing, the memory module is not recognized until either a power cycle occurs, or until the controller is placed in a non-executing mode (program mode, suspend mode or fault condition).

Specifications

Controller Specifications

Table A.1 General Specifications

Description		1762-					
		L24AWA	L24BWA	L24BXB	L40AWA	L40BWA	L40BXB
Dimensions		Height: 90 mm, 104 mm (with DIN latch open) Width: 110 mm, Depth: 87 mm			Height: 90 mm 104 mm (with DIN latch open) Width: 160 mm, Depth: 87 mm		
Shipping Weight		0.9 kg (2.0 lbs)			1.1 kg (2.4 lbs)		
Number of I/O		14 inputs and 10 outputs			24 inputs, 16 outputs		
Power Supply		100 to 240V ac (-15%, +10%) at 47 to 63 Hz		24V dc (-15%, +10%) Class 2 SELV	100 to 240V ac (-15%, +10%) at 47 to 63 Hz		24V dc (-15%, +10%) Class 2 SELV
Heat Dissipation		See Appendix F					
Power Supply Inrush		120V ac: 25A for 8 ms 240V ac: 40A for 4 ms		24V dc: 15A for 20 ms	120V ac: 25A for 8 ms 240V ac: 40A for 4 ms		24V dc: 15A for 30 ms
Power Supply Usage		68 VA	70 VA	27W	80 VA	82 VA	40W
Power Supply Output	5V dc	400 mA	400 mA[1]	400 mA	600 mA	600 mA[2]	600 mA
	24V dc	350 mA	350 mA[1]	350 mA	500 mA	500 mA[2]	500 mA
Sensor Power Output		none	250 mA at 24V dc AC Ripple < 500 mV peak-to-peak 400 µF max.[1]	none	none	400 mA at 24V dc AC Ripple < 500 mV peak-to-peak 400 µF max.[2]	none
Input Circuit Type		120V ac	24V dc sink/source	24V dc sink/source	120V ac	24V dc sink/source	24V dc sink/source
Output Circuit Type		Relay	Relay	Relay/FET	Relay	Relay	Relay/FET
Operating Temp.		+0°C to +55°C (+32°F to +131°F) ambient					
Storage Temp.		-40°C to +85°C (-40°F to +185°F) ambient					
Operating Humidity		5% to 95% relative humidity (non-condensing)					
Vibration		Operating: 10 to 500 Hz, 5G, 0.030 in. max. peak-to-peak, 2 hours each axis Relay Operation: 1.5G					
Shock		Operating: 30G; 3 pulses each direction, each axis Relay Operation: 7G Non-Operating: 50G panel mounted (40G DIN Rail mounted); 3 pulses each direction, each axis					

Table A.1 General Specifications

Description	1762-					
	L24AWA	**L24BWA**	**L24BXB**	**L40AWA**	**L40BWA**	**L40BXB**
Agency Certification	• UL 508 • C-UL under CSA C22.2 no. 142 • Class I, Div. 2, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 no. 213) • CE/C-Tick compliant for all applicable directives					
Electrical/EMC	The controller has passed testing at the following levels: • IEC1000-4-2: 4 kV contact, 8 kV air, 4 kV indirect • IEC1000-4-3: 10V/m, 80 to 1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier • IEC1000-4-4: 2 kV, 5 kHz; communications cable: 1 kV, 5 kHz • IEC1000-4-5: communications cable 1 kV galvanic gun I/O: 2 kV CM (common mode), 1 kV DM (differential mode) AC Power Supply: 4 kV CM (common mode), 2 kV DM (differential mode) DC Power Supply: 500V CM (common mode), 500V DM (differential mode) • IEC1000-4-6: 10V, communications cable 3V					
Terminal Screw Torque	0.791 Nm (7 in-lb) rated					

(1) Do not allow the total load power consumed by the 5V dc, 24V dc, and sensor power outputs to exceed 12W.

(2) Do not allow the total load power consumed by the 5V dc, 24V dc, and sensor power outputs to exceed 16W.

See Appendix F for system validation worksheets.

Table A.2 Input Specifications

Description	1762-L24AWA 1762-L40AWA	1762-L24BWA, -L24BXB, -L40BWA, -L40BXB	
		Inputs 0 through 3	**Inputs 4 and higher**
On-State Voltage Range	79 to 132V ac	14 to 24V dc (+10% at 55°C/131°F) (+25% at 30°C/86°F)	10 to 24V dc (+10% at 55°C/131°F) (+25% at 30°C/86°F)
Off-State Voltage Range	0 to 20V ac	0 to 5V dc	
Operating Frequency	47 Hz to 63 Hz	0 Hz to 20 kHz	0 Hz to 1 kHz (scan time dependent)
On-State Current: • minimum • nominal • maximum	 • 5.0 mA at 79V ac • 12 mA at 120V ac • 16.0 mA at 132V ac	 • 2.5 mA at 14V dc • 7.3 mA at 24V dc • 12.0 mA at 30V dc	 • 2.0 mA at 10V dc • 8.9 mA at 24V dc • 12.0 mA at 30V dc
Off-State Leakage Current	2.5 mA max.	1.5 mA min.	
Nominal Impedance	12KΩ at 50 Hz 10KΩ at 60 Hz	3.3KΩ	2.7KΩ
Inrush Current (max.) at 120V ac	250 mA	Not Applicable	

Table A.3 Output Specifications - General

Description		1762			
		-L24AWA -L24BWA	-L24BXB	-L40AWA -L40BWA	-L40BXB
Relay and FET Outputs					
Maximum Controlled Load		1440 VA	–	1440 VA	1440 VA
Maximum Continuous Current:					
Current per Group Common		8A	7.5A	8A	8A
Current per Controller	at 150V max	30A or total of per-point loads, whichever is less			
	at 240V max	20A or total of per-point loads, whichever is less			
Relay Outputs					
Turn On Time/Turn Off Time		10 msec (minimum)(1)			
Load Current		10 mA (minimum)			

(1) scan time dependent

Table A.4 BXB FET Output Specifications

Description	General Operation	High Speed Operation(1) (Output 2 Only)
Power Supply Voltage	24V dc (-15%, +10%)	
On-State Voltage Drop:		
•at maximum load current	•1V dc	•Not Applicable
•at maximum surge current	•2.5V dc	•Not Applicable
Current Rating per Point		
•maximum load	•See graphs below.	•100 mA
•minimum load	•1.0 mA	•10 mA
•maximum leakage	•1.0 mA	•1.0 mA

Maximum Output Current (temperature dependent):

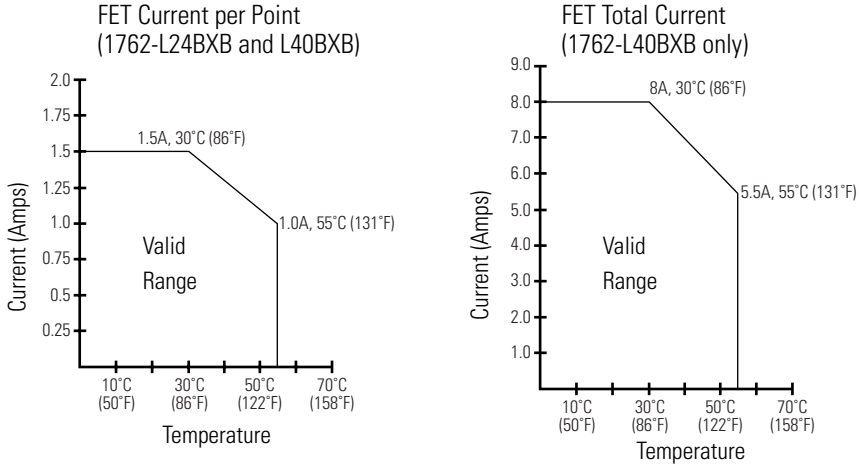


Table A.4 BXB FET Output Specifications

Description	General Operation	High Speed Operation[1] (Output 2 Only)
Surge Current per Point: • peak current • maximum surge duration • maximum rate of repetition at 30°C (86°F) • maximum rate of repetition at 55°C (131°F)	 • 4.0A • 10 msec • once every second • once every 2 seconds	 • Not Applicable • Not Applicable • Not Applicable • Not Applicable
Turn-On Time (maximum)	0.1 msec	6 µsec
Turn-Off Time (maximum)	1.0 msec	18 µsec
Repeatability (maximum)	n/a	2 µsec
Drift (maximum)	n/a	1 µsec per 5°C (9°F)

(1) Output 2 is designed to provide increased functionality over the other FET outputs. Output 2 may be used like the other FET transistor outputs, but in addition, within a limited current range, it may be operated at a higher speed. Output 2 also provides a pulse train output (PTO) or pulse width modulation output (PWM) function.

Table A.5 AC Input Filter Settings

Nominal Filter Setting (ms)	ON Delay (ms)		OFF Delay (ms)	
	Minimum	Maximum	Minimum	Maximum
8	2	20	10	20

Table A.6 Fast DC Input Filter Settings (Inputs 0 to 3)

Nominal Filter Setting (ms)	ON Delay (ms)		OFF Delay (ms)		Maximum Counter Frequency (Hz) 50% Duty Cycle
	Minimum	Maximum	Minimum	Maximum	
0.025	0.005	0.025	0.005	0.025	20.0 kHz
0.075	0.040	0.075	0.045	0.075	6.7 kHz
0.100	0.050	0.100	0.060	0.100	5.0 kHz
0.250	0.170	0.250	0.210	0.250	2.0 kHz
0.500	0.370	0.500	0.330	0.500	1.0 kHz
1.00	0.700	1.000	0.800	1.000	0.5 kHz
2.000	1.700	2.000	1.600	2.000	250 Hz
4.000	3.400	4.000	3.600	4.000	125 Hz
8.000[1]	6.700	8.000	7.300	8.000	63 Hz
16.000	14.000	16.000	14.000	16.000	31 Hz

(1) This is the default setting.

Table A.7 Normal DC Input Filter Settings (Inputs 4 and higher)

Nominal Filter Setting (ms)	ON Delay (ms)		OFF Delay (ms)		Maximum Frequency (Hz) 50% Duty Cycle
	Minimum	Maximum	Minimum	Maximum	
0.500	0.090	0.500	0.020	0.500	1.0 kHz
1.000	0.500	1.000	0.400	1.000	0.5 kHz
2.000	1.100	2.000	1.300	2.000	250 Hz
4.000	2.800	4.000	2.700	4.000	125 Hz
8.000(1)	5.800	8.000	5.300	8.000	63 Hz
16.000	11.000	16.000	10.000	16.000	31 Hz

(1) This is the default setting.

Table A.8 Relay Contact Ratings

Maximum Volts	Amperes		Amperes Continuous	Volt-Amperes	
	Make	Break		Make	Break
240V ac	7.5A	0.75A	2.5A(1)	1800 VA	180 VA
120V ac	15A	1.5A	2.5A(1)	1800 VA	180 VA
125V dc	0.22A(2)		1.0A	28 VA	
24V dc	1.2A(2)		2.0A		

(1) 1.5A above 40°C.

(2) For dc voltage applications, the make/break ampere rating for relay contacts can be determined by dividing 28 VA by the applied dc voltage. For example, 28 VA/48V dc = 0.58A. For dc voltage applications less than 14V, the make/break ratings for relay contacts cannot exceed 2A.

Table A.9 Working Voltage (1762-L24AWA, 1762-L40AWA)

Description	1762-L24AWA, 1762-L40AWA
Power Supply Input to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V ac Working Voltage (IEC Class 2 reinforced insulation)
Input Group to Backplane Isolation	Verified by one of the following dielectric tests:1517V ac for 1 second or 2145V dc for 1 second
	132V ac Working Voltage (IEC Class 2 reinforced insulation)
Input Group to Input Group Isolation	Verified by one of the following dielectric tests:1517V ac for 1 second or 2145V dc for 1 second
	132V ac Working Voltage (basic insulation)
Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V ac Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Output Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1second
	265V ac Working Voltage (basic insulation) 150V ac Working Voltage (IEC Class 2 reinforced insulation).□

Table A.10 Working Voltage (1762-L24BWA, 1762-L40BWA)

Description	1762-L24BWA, 1762-L40BWA
Power Supply Input to Backplane Isolation	Verified by one of the following dielectric tests:1836V ac for 1 second or 2596V dc for 1 second
	265V ac Working Voltage (IEC Class 2 reinforced insulation)
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V ac Working Voltage (IEC Class 2 reinforced insulation).
Output Group to Output Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V ac Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation)

Table A.11 Working Voltage (1762-L24BXB, 1762-L40BXB)

Description	1762-L24BXB, 1762-L40BXB
Input Group to Backplane Isolation and Input Group to Input Group Isolation	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
FET Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1200V ac for 1 second or 1697V dc for 1 second
	75V dc Working Voltage (IEC Class 2 reinforced insulation)
Relay Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V ac Working Voltage (IEC Class 2 reinforced insulation).
Relay Output Group to Relay Output Group and FET Output Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 second or 2596V dc for 1 second
	265V ac Working Voltage (basic insulation) 150V Working Voltage (IEC Class 2 reinforced insulation)

Expansion I/O Specifications

Discrete I/O Modules

Table A.12 General Specifications

Specification	Value
Dimensions	90 mm (height) x 87 mm (depth) x 40.4 mm (width) height including mounting tabs is 110 mm 3.54 in. (height) x 3.43 in. (depth) x 1.59 in. (width) height including mounting tabs is 4.33 in.
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Operating Temperature	0°C to +55°C (+32°F to +131°F)
Operating Humidity	5% to 95% non-condensing
Operating Altitude	2000 meters (6561 feet)
Vibration	Operating: 10 to 500 Hz, 5G, 0.030 in. max. peak-to-peak, 2 hours per axis Relay Operation: 1.5G
Shock	Operating: 30G panel mounted, 3 pulses per axis Relay Operation: 7G Non-Operating: 50G panel mounted, 3 pulses per axis (40G DIN Rail mounted)
Agency Certification	C-UL certified (under CSA C22.2 No. 142) UL 508 listed CE compliant for all applicable directives
Hazardous Environment Class	Class I, Division 2, Hazardous Location, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No. 213)
Radiated and Conducted Emissions	EN50081-2 Class A
Electrical /EMC:	*The module has passed testing at the following levels:*
ESD Immunity (IEC1000-4-2)	4 kV contact, 8 kV air, 4 kV indirect
Radiated Immunity (IEC1000-4-3)	10 V/m, 80 to 1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier
Fast Transient Burst (IEC1000-4-4)	2 kV, 5 kHz
Surge Immunity (IEC1000-4-5)	2 kV common mode, 1 kV differential mode
Conducted Immunity (IEC1000-4-6)	10V, 0.15 to 80 MHz(1)

(1) Conducted Immunity frequency range may be 150 kHz to 30 MHz if the Radiated Immunity frequency range is 30 MHz to 1000 MHz.

Table A.13 Input Specifications

Specification	1762-IA8	1762-IQ8	1762-IQ16
Approximate Shipping Weight (With Carton)	209g (0.46 lbs.)	200g (0.44 lbs.)	230 g (0.51 lbs.)
Voltage Category	100/120V ac	24V dc (sink/source)(1)	24V dc (sink/source)(1)
Operating Voltage Range	79V ac to 132V ac at 47 Hz to 63 Hz	10 to 30V dc at 30°C (86°F) 10 to 26.4V dc at 55°C (131°F)	10 to 30V dc at 30°C (86°F) 10 to 26.4V dc at 55°C (131°F)
Number of Inputs	8	8	16
Bus Current Draw (max.)	50 mA at 5V dc (0.25W)	50 mA at 5V dc (0.25W)	60 mA at 5V dc (0.3W)
Heat Dissipation (max.)	2.0 Watts	3.7 Watts	4.2 Watts at 26.4V 5.3 Watts at 30V
Signal Delay (max.)	On Delay: 20.0 ms Off Delay: 20.0 ms	On Delay: 8.0 ms Off Delay: 8.0 ms	On Delay: 8.0 ms Off Delay: 8.0 ms
Off-State Voltage (max.)	20V ac	5V dc	5V dc
Off-State Current (max.)	2.5 mA	1.5 mA	1.5 mA
On-State Voltage (min.)	79V ac (min.) 132V ac (max.)	10V dc	10V dc
On-State Current	5.0 mA (min.) at 79V ac 47 Hz 12.0 mA (nominal) at 120V ac 60 Hz 16.0 mA (max.) at 132V ac 63 Hz	2.0 mA min. at 10V dc 8.0 mA nominal at 24V dc 12.0 mA max. at 30V dc	2.0 mA min. at 10V dc 8.0 mA nominal at 24V dc 12.0 mA max. at 30V dc
Inrush Current (max.)	250 mA	Not Applicable	Not Applicable
Nominal Impedance	12K Ω at 50 Hz 10K Ω at 60 Hz	3K Ω	3K Ω
Power Supply Distance Rating	6 (The module may not be located more than 6 modules away from the power supply.)		
IEC Input Compatibility	Type 1+	Type 1+	Type 1+
Isolated Groups	Group 1: inputs 0 to 7 (internally connected commons)	Group 1: inputs 0 to 7 (internally connected commons)	Group 1: inputs 0 to 7; Group 2: inputs 8 to 15
Input Group to Backplane Isolation	Verified by one of the following dielectric tests: 1517V ac for 1 sec. or 2145V dc for 1 sec. 132V ac working voltage (IEC Class 2 reinforced insulation)	Verified by one of the following dielectric tests: 1200V ac for 1 sec. or 1697V dc for 1 sec. 75V dc working voltage (IEC Class 2 reinforced insulation)	
Vendor I.D. Code	1		
Product Type Code	7		
Product Code	114	96	97

(1) Sinking/Sourcing Inputs - Sourcing/sinking describes the current flow between the I/O module and the field device. Sourcing I/O circuits supply (source) current to sinking field devices. Sinking I/O circuits are driven by a current sourcing field device. Field devices connected to the negative side (DC Common) of the field power supply are sinking field devices. Field devices connected to the positive side (+V) of the field supply are sourcing field devices.

Table A.14 Output Specifications

Specification	1762-OA8	1762-OB8	1762-OB16	1762-OW8	1762-OW16
Approximate Shipping Weight (With Carton)	215g (0.48 lbs.)	210g (0.46 lbs.)	235g (0.52 lbs.)	228g (0.50 lbs.)	285g (0.63lbs.)
Voltage Category	100 to 240V ac	24V dc	24V dc	AC/DC normally open relay	AC/DC normally open relay
Operating Voltage Range	85V ac to 265V ac @ 47 to 63 Hz	20.4V dc to 26.4V dc	20.4V dc to 26.4V dc	5 to 265V ac 5 to 125V dc	5 to 265V ac 5 to 125V dc
Number of Outputs	8	8	16	8	16
Bus Current Draw (max.)	115 mA at 5V dc (0.575W)	115 mA at 5V dc (0.575W)	175 mA at 5V dc (0.88W)	80 mA at 5V dc (0.40W) 90 mA at 24V dc (2.16W)	120 mA at 5V dc (0.60W) 140 mA at 24V dc (3.36W)
Heat Dissipation (max.)	2.9 Watts	1.61 Watts	2.9 Watts at 30°C (86°F) 2.1 Watts at 55°C (131°F)	2.9 Watts	5.6 Watts
Signal Delay (max.) – resistive load	On Delay: 1/2 cycle Off Delay: 1/2 cycle	On Delay: 0.1 ms Off Delay: 1.0ms	On Delay: 0.1 ms Off Delay: 1.0 ms	On Delay: 10 ms Off Delay: 10 ms	On Delay: 10 ms Off Delay: 10 ms
Off-State Leakage (max.)	2 mA @ 132V, 2.5 mA @ 265V	1.0 mA	1.0 mA	0 mA	0 mA
On-State Current (min.)	10 mA	1.0 mA	1.0 mA	10 mA	10 mA
On-State Voltage Drop (maximum)	1.5V @ 0.5 A	1.0V dc	1.0V dc	Not Applicable	Not Applicable
Continuous Current per Point (max.)	0.25 A @ 55°C (131°F) 0.5A @ 30°C (86°F)	0.5A at 55°C (131°F) 1.0A at 30°C (86°F)	0.5A at 55°C (131°F) 1.0A at 30°C (86°F)	2.5 A (Also see "Relay Contact Ratings" on page A-5.)	
Continuous Current per Common (max.)	1.0 A @ 55°C (131°F) 2.0 A @ 30°C (86°F)	4.0A at 55°C (131°F) 8.0A at 30°C (86°F)	4.0A at 55°C (131°F) 8.0A at 30°C (86°F)	8 A	8A
Continuous Current per Module (max.)	2.0 A @ 55°C (131°F) 4.0 A @ 30°C (86°F)	4.0 A at 55°C; 8.0 A at 30°C	4.0A at 55°C (131°F) 8.0A at 30°C (86°F)	16 A	16A
Surge Current (maximum)	5.0 A (Repeatability is once every 2 seconds for a duration of 25 msec.	2.0A (Repeatability is once every 2 seconds at 55°C (131°F), once every second at 30°C (86°F) for a duration of 10 msec.)	2.0A (Repeatability is once every 2 seconds at 55°C (131°F), once every second at 30°C (86°F) for a duration of 10 msec.)	See "Relay Contact Ratings" on page A-5	
Power Supply Distance Rating	6 (The module may not be more than 6 modules away from the power supply.)				

Table A.14 Output Specifications

Specification	1762-OA8	1762-OB8	1762-OB16	1762-OW8	1762-OW16
Isolated Groups	Group 1: Outputs 0 to 3 Group 2: Outputs 4 to 7	Group 1: Outputs 0 to 7	Group 1: Outputs 0 to 15	Group 1: Outputs 0 to 3 Group 2: Outputs 4 to 7	Group 1: Outputs 0 to 7 Group 2: Outputs 8 to 15
Output Group to Backplane Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 sec. or 2596V dc for 1 sec. 265V ac working voltage (IEC Class 2 reinforced insulation)	Verified by one of the following dielectric tests: 1200V ac for 1 sec. or 1697V dc for 1 sec. 75V dc working voltage (IEC Class 2 reinforced insulation)		Verified by one of the following dielectric tests: 1836V ac for 1 sec. or 2596V dc for 1 sec. 265V ac working voltage (IEC Class 2 reinforced insulation)	
Output Group to Output Group Isolation	Verified by one of the following dielectric tests: 1836V ac for 1 sec. or 2596V dc for 1 sec. 265V ac working voltage (IEC Class 2 reinforced insulation)	Not Applicable		Verified by one of the following dielectric tests: 1836V ac for 1 sec. or 2596V dc for 1 sec. 265V ac working voltage (basic insulation) 150V ac working voltage (IEC Class 2 reinforced insulation)	
Vendor I.D. Code	1	1	1	1	1
Product Type Code	7	7	7	7	7
Product Code	119	101	103	120	121

Table A.15 Relay Contact Ratings (1762-OW8 and 1762-OW16)

Maximum Volts	Amperes		Amperes Continuous	Volt-Amperes	
	Make	Break		Make	Break
240V ac	7.5A	0.75A	2.5A(1)	1800 VA	180 VA
120V ac	15A	1.5A	2.5A(1)	1800 VA	180 VA
125V dc	0.22A(2)		1.0A	28 VA	
24V dc	1.2A(2)		2.0A		

(1) 1.5A above 40°C.

(2) For dc voltage applications, the make/break ampere rating for relay contacts can be determined by dividing 28 VA by the applied dc voltage. For example, 28 VA/48V dc = 0.58A. For dc voltage applications less than 14V, the make/break ratings for relay contacts cannot exceed 2A.

Analog Modules

Table A.16 General Specifications

Specification	1762-IF2OF2 and 1762-IF4
Dimensions	90 mm (height) x 87 mm (depth) x 40 mm (width) height including mounting tabs is 110 mm 3.54 in. (height) x 3.43 in. (depth) x 1.58 in. (width) height including mounting tabs is 4.33 in.
Approximate Shipping Weight (with carton)	1762-IF2OF2: 240g (0.53 lbs.) 1762-IF4: 235g (0.521 lbs.)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Operating Temperature	0°C to +55°C (-32°F to +131°F)
Operating Humidity	5% to 95% non-condensing
Operating Altitude	2000 meters (6561 feet)
Vibration	Operating: 10 to 500 Hz, 5G, 0.030 in. max. peak-to-peak
Shock	Operating: 30G
Module Power LED	On: indicates power is applied.
Recommended Cable	Belden™ 8761 (shielded)
Agency Certification	C-UL certified (under CSA C22.2 No. 142) UL 508 listed CE compliant for all applicable directives
Hazardous Environment Class	Class I, Division 2, Hazardous Location, Groups A, B, C, D (UL 1604, C-UL under CSA C22.2 No. 213)
Noise Immunity	NEMA standard ICS 2-230
Radiated and Conducted Emissions	EN50081-2 Class A
Electrical /EMC:	*The module has passed testing at the following levels:*
ESD Immunity (IEC1000-4-2)	4 kV contact, 8 kV air, 4 kV indirect
Radiated Immunity (IEC1000-4-3)	10 V/m, 80 to 1000 MHz, 80% amplitude modulation, +900 MHz keyed carrier
Fast Transient Burst (IEC1000-4-4)	2 kV, 5 kHz
Surge Immunity (IEC1000-4-5)	1 kV galvanic gun
Conducted Immunity (IEC1000-4-6)	10V, 0.15 to 80 MHz(1)

(1) Conducted Immunity frequency range may be 150 kHz to 30 MHz if the Radiated Immunity frequency range is 30 MHz to 1000 MHz.

Table A.17 Common Specifications

Specification	1762-IF2OF2	1762-IF4
Approximate Shipping Weight (with carton)	240g (0.53 lbs.)	
Bus Current Draw (max.)	40 mA at 5V dc 105 mA at 24V dc	40 mA at 5V dc 50 mA at 24V dc
Analog Normal Operating Range	Voltage: 0 to 10V dc Current: 4 to 20 mA	Voltage: -10 to +10V dc Current: 4 to 20 mA
Full Scale(1) Analog Ranges	Voltage: 0 to 10.5V dc Current: 0 to 21 mA	Voltage: -10.5 to +10.5V dc Current: -21 to +21 mA
Resolution	12 bits (unipolar)	15 bits
Repeatability(2)	±0.1%	±0.1%
Input and Output Group to System Isolation	30V ac/30V dc rated working voltage(3) (N.E.C. Class 2 required) (IEC Class 2 reinforced insulation) type test: 500V ac or 707V dc for 1 minute	
Vendor I.D. Code	1	1
Product Type Code	10	10
Product Code	75	67

(1) The over- or under-range flag comes on when the normal operating range (over/under) is exceeded. The module continues to convert the analog input up to the maximum full scale range.

(2) Repeatability is the ability of the input module to register the same reading in successive measurements for the same input signal.

(3) Rated working voltage is the maximum continuous voltage that can be applied at the terminals with respect to earth ground.

Table A.18 Input Specifications

Specification	1762-IF2OF2	1762-IF4
Number of Inputs	2 differential (unipolar)	4 differential (bipolar)
Update Time (typical)	2.5 ms	130, 250, 290, 450, 530 ms (selectable)
A/D Converter Type	Successive approximation	Successive approximation
Common Mode Voltage Range(1)	±27V	±27V
Common Mode Rejection(2)	> 55 dB at 50 and 60 Hz	> 55 dB at 50 and 60 Hz
Non-linearity (in percent full scale)	±0.1%	±0.1%
Typical Overall Accuracy(3)	±0.5% full scale at 0 to 55°C ±0.3% full scale at 25°C	±0.3% full scale at 0 to 55°C ±0.24% full scale at 25°C
Input Impedance	Voltage Terminal: 200KΩ Current Terminal: 250Ω	Voltage Terminal: 200KΩ Current Terminal: 275Ω

Table A.18 Input Specifications

Specification	1762-IF2OF2	1762-IF4
Current Input Protection	±32 mA	±32 mA
Voltage Input Protection	±30V	±30V
Channel Diagnostics	Over or under range or open circuit condition by bit reporting for analog inputs.	Over or under range or open circuit condition by bit reporting for analog inputs.

(1) For proper operation, both the plus and minus input terminals must be within ±27V of analog common.

(2) V_{cm} = 1 V_{pk-pk} AC

(3) V_{cm} = 0 (includes offset, gain, non-linearity and repeatability error terms)

Table A.19 Output Specifications

Specification	1762-IF2OF2
Number of Outputs	2 single-ended (unipolar)
Update Time (typical)	4.5 ms
D/A Converter Type	Resistor string
Resistive Load on Current Output	0 to 500 Ω (includes wire resistance)
Load Range on Voltage Output	> 1KΩ
Reactive Load, Current Output	< 0.1 mH
Reactive Load, Voltage Output	< 1 μF
Typical Overall Accuracy(1)	±1% full scale at 0 to 55°C ±0.5% full scale at 25°C
Output Ripple range 0 to 500 Hz (referred to output range)	< ±0.1%
Non-linearity (in percent full scale)	< ±0.5%
Open and Short-Circuit Protection	Continuous
Output Protection	±32 mA

(1) Includes offset, gain, non-linearity and repeatability error terms.

Table A.20 Valid Input/Output Data Word Formats/Ranges for 1762-IF2OF2

Normal Operating Range	Full Scale Range	RAW/Proportional Data	Scaled-for-PID
0V to 10V dc	10.5V dc	32760	16380
	0.0V dc	0	0
4mA to 20mA	21.0mA	32760	16380
	20.0mA	31200	15600
	4.0mA	6240	3120
	0.0mA	0	0

Controller Dimensions

See Controller Mounting Dimensions on page 2-13.

Expansion I/O Dimensions

See 1762 Expansion I/O Dimensions on page 2-17.

Replacement Parts

MicroLogix 1200 Replacement Kits

Controllers Replacement Doors

Catalog Number 1762-RPLDR1

The controller door kit consists of:

- Two memory module doors
- Two RS-232 communication port doors
- Two expansion bus doors

Controller Replacement Door Labels

Catalog Number 1762-RPLTLBL1

The controller terminal door label kit consists of:

- Four labels each for all available controllers

Controller Replacement DIN Latches

Catalog Number 1762-RPLDIN1

The controller DIN latch kit consists of:

- Five DIN latches for controllers

Controller 40-Point Replacement Terminal Blocks

Catalog Number 1762-RPLRTB40

The 40-point controller removable terminal blocks kit consists of:

- one 25-point double row terminal block
- one 29-point double row terminal block

(Both terminal blocks for a 40-point controller.)

Controller 24-Point Terminal Doors

Catalog Number 1762-RPLTDR24

The 24-point controller terminal door kit consists of:

- Four terminal doors
- Four sub-terminal covers.

(Enough doors for two 24-point controllers.)

Controller 40-Point Terminal Doors

Catalog Number 1762-RPLTDR40

The 40-point controller terminal door kit consists of:

- Four terminal doors
- Four sub-terminal covers

(Enough doors for two 40-point controllers.)

1762 Expansion I/O

Expansion I/O Replacement Doors

Catalog Number 1762-RPLDR2

The expansion I/O door kit consists of:

- Two expansion I/O terminal doors
- Two expansion I/O (bus doors)

Expansion I/O Replacement DIN Latches

Catalog Number 1762-RPLDIN2

The expansion I/O DIN latch kit consists of:

- Five DIN latches for expansion I/O

Expansion I/O Replacement Door Labels

Catalog Number 1762-RPLDTLBL2

The expansion I/O terminal door label kit consists of:

- Four labels each for all available modules

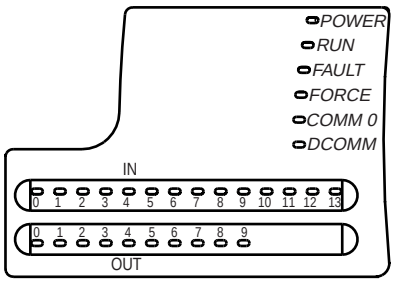
Troubleshooting Your System

This chapter describes how to troubleshoot your controller. Topics include:

- understanding the controller LED status
- controller error recovery model
- analog expansion I/O diagnostics and troubleshooting
- calling Rockwell Automation for assistance

Understanding the Controller LED Status

Figure C.1 Controller LED Location



The controller status LEDs provide a mechanism to determine the current status of the controller if a programming device is not present or available.

Table C.1 Controller LED Indicators

LED	Color	Indicates
POWER	off	No input power, or power error condition
	green	Power on
RUN	off	Not executing the user program
	green	Executing the user program in run mode
	green flashing	Memory module transfer occurring
FAULT	off	No fault detected
	red flashing	Application fault detected
	red	Controller hardware faulted
FORCE	off	No forces installed
	amber	Forces installed
COMM 0	off	Not transmitting via RS-232 port
	green	Transmitting via RS-232 port
DCOMM	off	Configured communications
	green	Default communications
INPUTS	off	Input is not energized
	amber	Input is energized (terminal status)
OUTPUTS	off	Output is not energized
	amber	Output is engerized (logic status)

Normal Operation

The POWER and RUN LEDs are on. If a force condition is active, the FORCE LED turns on and remains on until all forces are removed.

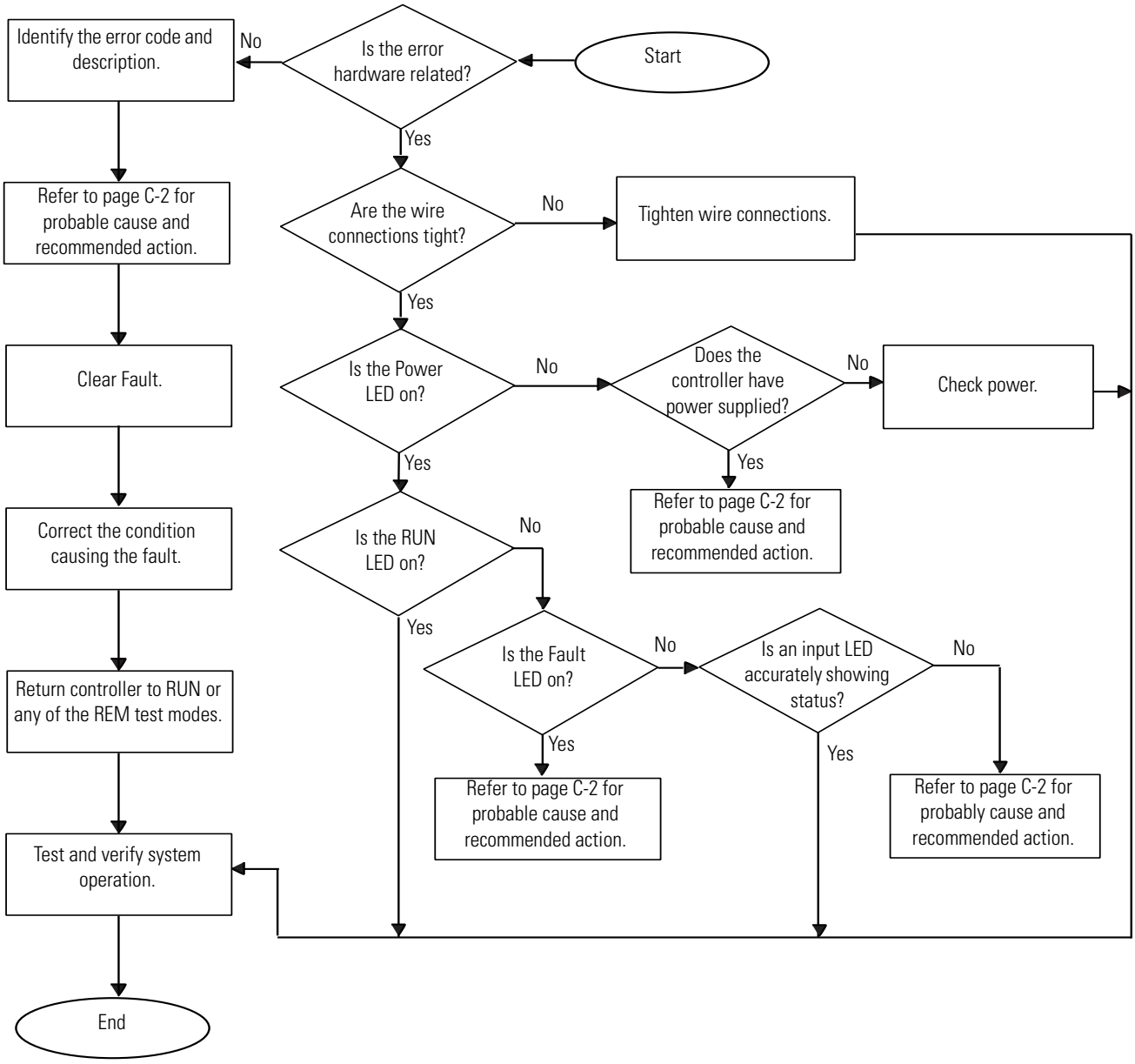
Error Conditions

If an error exists within the controller, the controller LEDs operate as described in the following table.

If the LEDS indicate:	The Following Error Exists	Probable Cause	Recommended Action
All LEDs off	No input power or power supply error	No line Power	Verify proper line voltage and connections to the controller.
		Power Supply Overloaded	This problem can occur intermittently if power supply is overloaded when output loading and temperature varies.
Power and FAULT LEDs on solid	Hardware faulted	Processor Hardware Error	Cycle power. Contact your local Allen-Bradley representative if the error persists.
		Loose Wiring	Verify connections to the controller.
Power LED on and FAULT LED flashing	Application fault	Hardware/Software Major Fault Detected	For error codes and Status File information, see *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, Publication 1762-RM001C-EN-P.
RUN FORCE FAULT LEDs all flashing	Operating system fault	Missing or Corrupt Operating System	See Missing/Corrupt OS LED Pattern on page D-2.

Controller Error Recovery Model

Use the following error recovery model to help you diagnose software and hardware problems in the micro controller. The model provides common questions you might ask to help troubleshoot your system. Refer to the recommended pages within the model for further help.



Analog Expansion I/O Diagnostics and Troubleshooting

Module Operation and Channel Operation

The module performs operations at two levels:

- module level
- channel level

Module-level operations include functions such as power-up, configuration, and communication with the controller.

Internal diagnostics are performed at both levels of operation. Both module hardware and channel configuration error conditions are reported to the controller. Channel over-range or under-range conditions are reported in the module's input data table. Module hardware errors are reported in the controller's I/O status file. Refer to the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001C-EN-P for more information.

When a fault condition is detected, the analog outputs are reset to zero.

Power-up Diagnostics

At module power-up, a series of internal diagnostic tests are performed.

Table C.2 Module Status LED State Table

If module status LED is:	Indicated condition:	Corrective action:
On	Proper Operation	No action required.
Off	Module Fault	Cycle power. If condition persists, replace the module. Call your local distributor or Allen-Bradley for assistance.

Critical and Non-Critical Errors

Non-critical module errors are recoverable. Channel errors (over-range or under-range errors) are non-critical. Non-critical error conditions are indicated in the module input data table. Non-critical configuration errors are indicated by the extended error code. See Table C.5 on page C-6.

Critical module errors are conditions that prevent normal or recoverable operation of the system. When these types of errors occur, the system leaves the run mode of operation. Critical module errors are indicated in Table C.5 on page C-6.

Module Error Definition Table

Analog module errors are expressed in two fields as four-digit Hex format with the most significant digit as "don't care" and irrelevant. The two fields are "Module Error" and "Extended Error Information". The structure of the module error data is shown below.

Table C.3 Module Error Table

"Don't Care" Bits				Module Error			Extended Error Information								
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hex Digit 4				**Hex Digit 3**			**Hex Digit 2**					**Hex Digit 1**			

Module Error Field

The purpose of the module error field is to classify module errors into three distinct groups, as described in the table below. The type of error determines what kind of information exists in the extended error information field. These types of module errors are typically reported in the controller's I/O status file. Refer to the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001C-EN-P for more information.

Table C.4 Module Error Types

Error Type	Module Error Field Value Bits 11 through 09 (Binary)	Description
No Errors	000	No error is present. The extended error field holds no additional information.
Hardware Errors	001	General and specific hardware error codes are specified in the extended error information field.
Configuration Errors	010	Module-specific error codes are indicated in the extended error field. These error codes correspond to options that you can change directly. For example, the input range or input filter selection.

Extended Error Information Field

Check the extended error information field when a non-zero value is present in the module error field. See Table C.5 on page C-6.

NOTE If no errors are present in the module error field, the extended error information field is set to zero.

Hardware Errors

General or module-specific hardware errors are indicated by module error code 2. See Table C.5.

Configuration Errors

If you set the fields in the configuration file to invalid or unsupported values, the module ignores the invalid configuration, generates a non-critical error, and keeps operating with the previous configuration.

The table below lists the configuration error codes defined for the module.

Error Codes

Table C.5 Extended Error Codes for 1762-IF2OF2

Error Type	Hex Equivalent(1)	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
No Error	X000	000	0 0000 0000	No error
General Common Hardware Error	X200	001	0 0000 0000	General hardware error; no additional information
	X201	001	0 0000 0001	Power-up reset state
Hardware-Specific Error	X210	001	0 0001 0000	Reserved
Configuration Error	X400	010	0 0000 0000	General configuration error; no additional information
	X401	010	0 0000 0001	Invalid input data format selected (channel 0)
	X402	010	0 0000 0010	Invalid input data format selected (channel 1)
	X403	010	0 0000 0011	Invalid output data format selected (channel 0)
	X404	010	0 0000 0100	Invalid output data format selected (channel 1)

(1) X represents “Don’t Care”.

Table C.6 Extended Error Codes for 1762-IF4

Error Type	Hex Equivalent(1)	Module Error Code	Extended Error Information Code	Error Description
		Binary	Binary	
No Error	X000	000	0 0000 0000	No error
General Common Hardware Error	X200	001	0 0000 0000	General hardware error; no additional information
	X201	001	0 0000 0001	Power-up reset state
Hardware-Specific Error	X300	001	1 0000 0000	Reserved
Configuration Error	X400	010	0 0000 0000	General configuration error; no additional information
	X401	010	0 0000 0001	Invalid range select (Channel 0)
	X402	010	0 0000 0010	Invalid range select (Channel 1)
	X403	010	0 0000 0011	Invalid range select (Channel 2)
	X404	010	0 0000 0100	Invalid range select (Channel 3)
	X405	010	0 0000 0101	Invalid filter select (Channel 0)
	X406	010	0 0000 0110	Invalid filter select (Channel 1)
	X407	010	0 0000 0111	Invalid filter select (Channel 2)
	X408	010	0 0000 1000	Invalid filter select (Channel 3)
	X409	010	0 0000 1001	Invalid format select (Channel 0)
	X40A	010	0 0000 1010	Invalid format select (Channel 1)
	X40B	010	0 0000 1011	Invalid format select (Channel 2)
	X40C	010	0 0000 1100	Invalid format select (Channel 3)

(1) X represents "Don't Care".

Calling Rockwell Automation for Assistance

If you need to contact Rockwell Automation or local distributor for assistance, it is helpful to obtain the following (prior to calling):

- controller type, series letter, revision letter, and firmware (FRN) number of the controller
- controller LED status
- controller error codes (Refer to *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, Publication 1762-RM001C-EN-P for error code information.)

Using Control Flash to Upgrade Your Operating System

The operating system (OS) can be upgraded through the communication port on the controller. In order to download a new operating system, you must have the following:

- ControlFlash™ Upgrade Kit containing the new OS
- a Windows 95®, Windows 98® or Windows NT™ based computer to run the download software.

The ControlFlash™ Upgrade Kit includes:

- the operating system upgrade to be downloaded
- the ControlFlash programming tool, along with its support drivers and on-line help
- a readme first file explaining how to upgrade the operating system

Preparing for Upgrade

Before upgrading the controller's operating system, you must:

- install ControlFlash software on your personal computer
- prepare the controller for updating

IMPORTANT Installing a new operating system deletes the user program. After the operating system upgrade is successful, you must transfer your control program back to the controller. The communication parameters are described on Table 4.1 on page 4-1.

Install ControlFlash Software

Double click the 1762-LSC_FRNxx.exe file to install the operating system upgrade (where xx is the firmware revision number).

Prepare the Controller for Updating

Controller Configuration

The controller must be configured for default communications (use communications toggle push button; DCOMM LED on) and be in the Program mode to allow the download of a new operating system.

Sequence of Operation

The following steps detail the key events in the upgrade process.

1. Controller mode and communications parameters are checked.
2. Download begins.
3. During the download, the Force, Battery, and Comms LEDs perform a walking bit pattern.
4. When the download is complete, the integrity of the new OS is checked. If the new OS is corrupt, the controller sends an error message to the download tool and flashes the Missing or Corrupt OS LED pattern. See Missing/Corrupt OS LED Pattern below.
5. Following a successful transfer, the Power, Force, and Battery LEDs flash on and remain on for five seconds. Then the controller resets.

Missing/Corrupt OS LED Pattern

When an operating system download is not successful or if the controller does not contain a valid operating system, the controller flashes the Run, Force, and Fault LEDS on and off.

Understanding the Communication Protocols

Use the information in this appendix to understand the differences in communication protocols. The following protocols are supported from the RS-232 communication channel:

- DF1 Full-Duplex
- DF1 Half-Duplex Slave
- DH485
- Modbus
- ASCII

See **Chapter 4 Communication Connections** for information about required network devices and accessories.

RS-232 Communication Interface

The communications port on the MicroLogix 1200 utilizes an RS-232 interface. RS-232 is an Electronics Industries Association (EIA) standard that specifies the electrical and mechanical characteristics for serial binary communication. It provides you with a variety of system configuration possibilities. (RS-232 is a definition of electrical characteristics; it is *not* a protocol.)

One of the biggest benefits of an RS-232 interface is that it lets you integrate telephone and radio modems into your control system (using the appropriate DF1 protocol only, not DH485 protocol).

DF1 Full-Duplex Protocol

DF1 Full-Duplex protocol provides a point-to-point connection between two devices. DF1 Full-Duplex protocol combines data transparency (American National Standards Institute ANSI - X3.28-1976 specification subcategory D1) and 2-way simultaneous transmission with embedded responses (subcategory F1).

The MicroLogix 1200 controllers support the DF1 Full-Duplex protocol via RS-232 connection to external devices, such as computers, or other controllers that support DF1 Full-Duplex.

DF1 is an open protocol. Refer to *DF1 Protocol and Command Set Reference Manual*, publication 1770-6.5.16, for more information.

DF1 Full-Duplex Operation

DF1 Full-Duplex protocol (also referred to as DF1 point-to-point protocol) is useful where RS-232 point-to-point communication is required. DF1 protocol controls message flow, detects and signals errors, and retries if errors are detected.

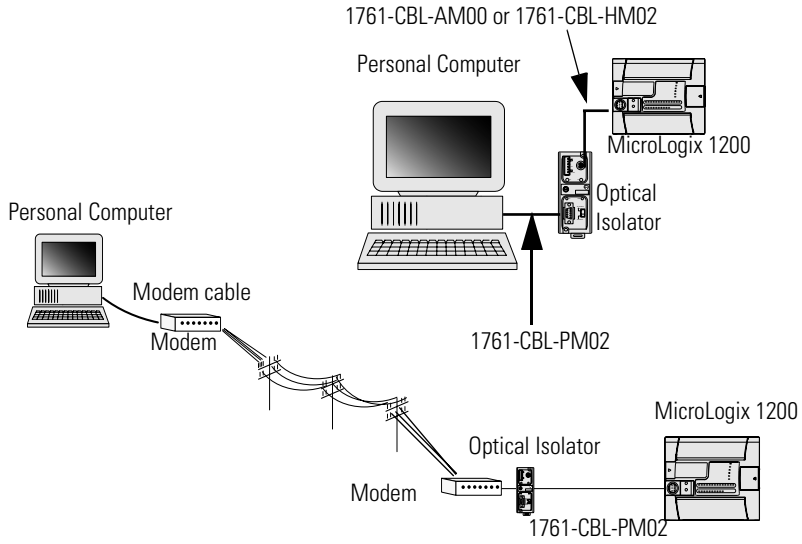
When the system driver is DF1 Full-Duplex, the following parameters can be changed:

Table E.1 DF1 Full-Duplex Configuration Parameters

Parameter	Options	Default
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19.2K, 38.4K	19.2K
Parity	none, even	none
Source ID (Node Address)	0 to 254 decimal	1
Control Line	no handshaking, Full-Duplex modem handshaking	no handshaking
Error Detection	CRC, BCC	CRC
Embedded Responses	auto-detect, enabled	auto detect
Duplicate Packet (Message) Detect	enabled, disabled	enabled
ACK Timeout	1 to 65535 counts (20 ms increments)	50 counts
NAK retries	0 to 255	3 retries
ENQ retries	0 to 255	3 retries
Stop Bits	not a setting, always 1	1

Example DF1 Full-Duplex Connections

For information about required network connecting equipment, see chapter 3, Connecting the System.



We recommend using an AIC+, catalog number 1761-NET-AIC, as your optical isolator.

DF1 Half-Duplex Protocol

DF1 Half-Duplex protocol is a multi-drop single master/multiple slave network. DF1 Half-Duplex protocol supports data transparency (American National Standards Institute ANSI - X3.28-1976 specification subcategory D1). In contrast to DF1 Full-Duplex, communication takes place in one direction at a time. You can use the RS-232 port on the MicroLogix 1200 as both a Half-Duplex programming port and a Half-Duplex peer-to-peer messaging port.

DF1 Half-Duplex Operation

The master device initiates all communication by "polling" each slave device. The slave device may only transmit message packets when it is polled by the master. It is the master's responsibility to poll each slave on a regular and sequential basis to allow slave devices an opportunity to communicate. During a polling sequence, the master polls a slave either repeatedly until the slave indicates that it has no more message packets to transmit or just one time per polling sequence, depending on how the master is configured.

An additional feature of the DF1 Half-Duplex protocol is that a slave device may enable a MSG instruction in its ladder program to send or request data to/from another slave. When the initiating slave is polled, the MSG instruction is sent to the master. The master recognizes that the message is not intended for it, but for another slave, so the master immediately forwards the message to the intended slave. The master does this automatically, you do not need to program the master to move data between slave nodes. This slave-to-slave transfer can also be used by programming software to allow slave-to-slave upload and download programs to processors (including the master) on the DF1 Half-Duplex link.

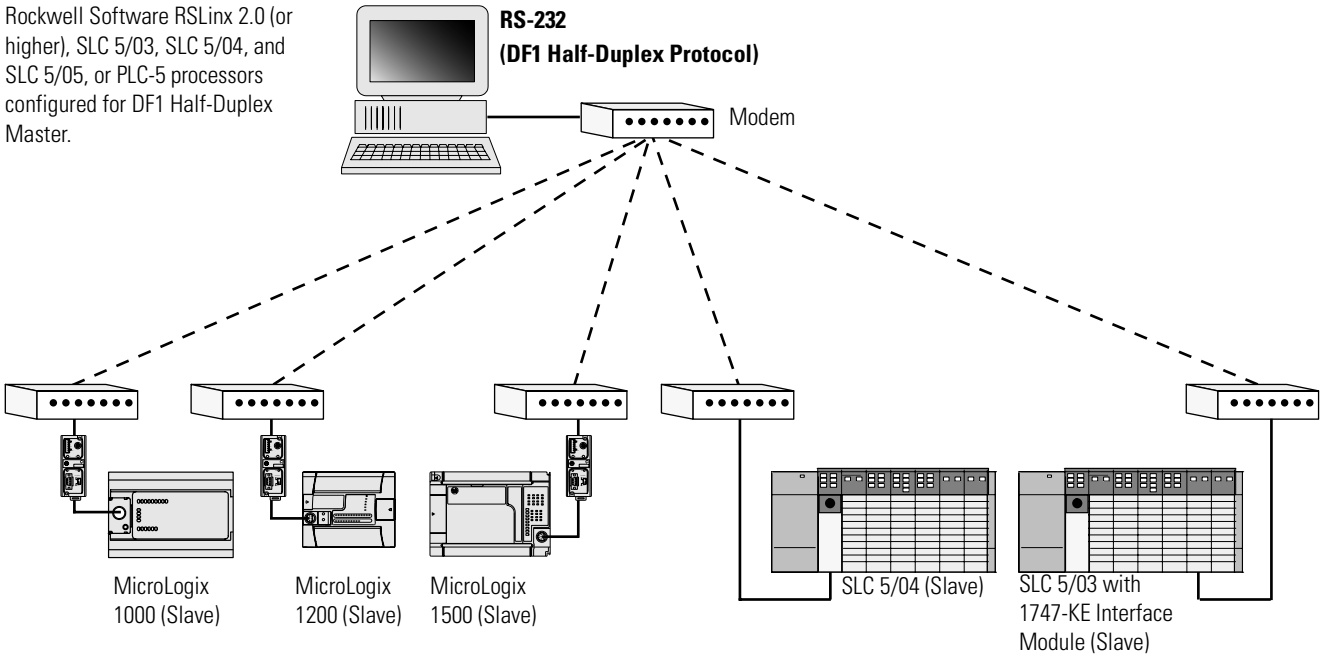
The MicroLogix 1200 can only act as a slave device. A device that can act as a master is required to "run" the network. Several Allen-Bradley products support DF1 Half-Duplex master protocol. They include the SLC 5/03™ and higher processors, enhanced PLC-5® processors and Rockwell Software RSLinx (version 2.x and higher).

DF1 Half-Duplex supports up to 255 devices (address 0 to 254) with address 255 reserved for master broadcasts. The MicroLogix 1200 supports broadcast reception. The MicroLogix 1200 also supports Half-Duplex modems using RTS/CTS hardware handshaking.

When the system driver is DF1 Half-Duplex Slave, available parameters include:

Table E.2 DF1 Half-Duplex Configuration Parameters

Parameter	Options
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19.2K, 38.4K
Parity	none, even
Source ID (Node Address)	0 to 254 decimal
Control Line	no handshaking, handshaking
Error Detection	CRC, BCC
EOT Suppression	enabled, disabled When EOT Suppression is enabled, the slave does not respond when polled if no message is queued. This saves modem transmission power and time when there is no message to transmit.
Duplicate Packet (Message) Detect	enabled, disabled Detects and eliminates duplicate responses to a message. Duplicate packets may be sent under noisy communication conditions if the sender's Message Retries are not set to 0.
Poll Timeout (x20 ms)	0 to 65535 (can be set in 20 ms increments) Poll Timeout only applies when a slave device initiates a MSG instruction. It is the amount of time that the slave device waits for a poll from the master device. If the slave device does not receive a poll within the Poll Timeout, a MSG instruction error is generated, and the ladder program needs to requeue the MSG instruction. If you are using a MSG instruction, it is recommended that a Poll Timeout value of zero not be used. Poll Timeout is disabled when set to zero.
RTS Off Delay (x20 ms)	0 to 65535 (can be set in 20 ms increments) Specifies the delay time between when the last serial character is sent to the modem and when RTS is deactivated. Gives the modem extra time to transmit the last character of a packet.
RTS Send Delay (x20 ms)	0 to 65535 (can be set in 20 ms increments) Specifies the time delay between setting RTS until checking for the CTS response. For use with modems that are not ready to respond with CTS immediately upon receipt of RTS.
Message Retries	0 to 255 Specifies the number of times a slave device attempts to resend a message packet when it does not receive an ACK from the master device. For use in noisy environments where message packets may become corrupted in transmission.
Pre Transmit Delay (x1 ms)	0 to 65535 (can be set in 1 ms increments) • When the Control Line is set to *no handshaking*, this is the delay time before transmission. Required for 1761-NET-AIC physical Half-Duplex networks. The 1761-NET-AIC needs delay time to change from transmit to receive mode. • When the Control Line is set to *DF1 Half-Duplex Modem*, this is the minimum time delay between receiving the last character of a packet and the RTS assertion.


Rockwell Software RSLinx 2.0 (or higher), SLC 5/03, SLC 5/04, and SLC 5/05, or PLC-5 processors configured for DF1 Half-Duplex Master.
RS-232
(DF1 Half-Duplex Protocol)
Modem
MicroLogix 1000 (Slave)
MicroLogix 1200 (Slave)
MicroLogix 1500 (Slave)
SLC 5/04 (Slave)
SLC 5/03 with 1747-KE Interface Module (Slave)

NOTE We recommend using isolation (1761-NET-AIC) between channel 0 of the MicroLogix controller and the modem.

Considerations When Communicating as a DF1 Slave on a Multi-drop Link

When communication is between either your programming software and a MicroLogix Programmable Controller or between two MicroLogix Programmable Controllers via a slave-to-slave connection on a larger multi-drop link, the devices depend on a DF1 Half-Duplex Master to give each of them permission to transmit in a timely manner. As the number of slave devices increase on the link (up to 254), the time between when your programming software or the MicroLogix Controller is polled also increases. This increase in time may also be large if you are using low baud rates.

As these time periods grow, the following values may need to be changed to avoid loss of communication:

- programming software: increase poll timeout and reply timeout values
- MicroLogix Programmable Controllers: increase poll timeout and reply timeout values

IMPORTANT If a program download is started when using DF1 Half Duplex but then is interrupted, due to electromagnetic interference or other events, discontinue communications to the controller for the ownership timeout period and then restart the program download. The ownership timeout period is 60 seconds. After the timeout, you can re-establish communications with the processor and try the program download again. The only other way to remove program ownership is to cycle power on the processor.

Using Modems with MicroLogix 1200 Programmable Controllers

The types of modems you can use with MicroLogix 1200 controllers include dial-up phone modems, leased-line modems, radio modems and line drivers.

For point-to-point Full-Duplex modem connections that do not require any modem handshaking signals to operate, use DF1 Full-Duplex protocol with no handshaking. For point-to-point Full-Duplex modem connections that require RTS/CTS handshaking, use DF1 Full-Duplex protocol with handshaking.

For multi-drop modem connections, or for point-to-point modem connections that require RTS/CTS handshaking, use DF1 Half-Duplex slave protocol. In this case, one (and only one) of the other devices must be configured for DF1 Half-Duplex master protocol.

IMPORTANT Never attempt to use DH485 protocol through modems under any circumstance.

NOTE All MicroLogix 1200 controllers support RTS/CTS modem handshaking when configured for DF1 Full-Duplex protocol with the control line parameter set to Full-Duplex Modem Handshaking or DF1 Half-Duplex slave protocol with the control line parameter set to “Half-Duplex Modem”. No other modem handshaking lines (i.e. Data Set Ready, Carrier Detect and Data Terminal Ready) are supported by any MicroLogix 1200 controllers.

Dial-Up Phone Modems

Some dial-up phone line modems support point-to-point Full-Duplex communications. A MicroLogix 1200 controller, on the receiving end of the dial-up connection, can be configured for DF1 Full-Duplex protocol with or without handshaking. The modem connected to the MicroLogix controller should support auto-answer. The MicroLogix 1200 supports ASCII out communications. Therefore, it can cause a modem to initiate or disconnect a phone call.

Leased-Line Modems

Leased-line modems are used with dedicated phone lines that are typically leased from the local phone company. The dedicated lines may be in a point-to-point topology supporting Full-Duplex communications between two modems or in a multi-drop topology supporting Half-Duplex communications between three or more modems.

Radio Modems

Radio modems may be implemented in a point-to-point topology supporting either Half-Duplex or Full-Duplex communications, or in a multi-drop topology supporting Half-Duplex communications between three or more modems.

Line Drivers

Line drivers, also called short-haul modems, do not actually modulate the serial data, but rather condition the electrical signals to operate reliably over long transmission distances (up to several miles). Line drivers are available in Full-Duplex and Half-Duplex models. Allen-Bradley's AIC+ Advanced Interface Converter is a Half-Duplex line driver that converts an RS-232 electrical signal into an RS-485 electrical signal, increasing the signal transmission distance from 50 to 4000 feet (8000 feet when bridged).

DH485 Communication Protocol

The information in this section describes the DH485 network functions, network architecture, and performance characteristics. It will also help you plan and operate a MicroLogix on a DH485 network.

DH485 Network Description

The DH485 protocol defines the communication between multiple devices that coexist on a single pair of wires. DH485 protocol uses RS-485 Half-Duplex as its physical interface. (RS-485 is a definition of electrical characteristics; it is *not* a protocol.) RS-485 uses devices that are capable of co-existing on a common data circuit, thus allowing data to be easily shared between devices.

The DH485 network offers:

- interconnection of 32 devices
- multi-master capability
- token passing access control
- the ability to add or remove nodes without disrupting the network
- maximum network segment of 1219 m (4000 ft)

The DH485 protocol supports two classes of devices: initiators and responders. All initiators on the network get a chance to initiate message transfers. To determine which initiator has the right to transmit, a token passing algorithm is used.

The following section describes the protocol used to control message transfers on the DH485 network.

DH485 Token Rotation

A node holding the token can send a message onto the network. Each node is allowed a fixed number of transmissions (based on the Token Hold Factor) each time it receives the token. After a node sends a message, it passes the token to the next device.

The allowable range of node addresses is 0 to 31. There must be at least one initiator on the network such as a MicroLogix controller, or an SLC 5/02™ or higher processor.

DH485 Configuration Parameters

When MicroLogix communications are configured for DH485, the following parameters can be changed:

Table E.3 DF1 Full-Duplex Configuration Parameters

Parameter	Options
Baud Rate	9600, 19.2K
Node Address	1 to 31 decimal
Token Hold Factor	1 to 4

See Appendix E Software Considerations for tips on setting the parameters listed above.

Devices that use the DH485 Network

In addition to the MicroLogix 1200 controllers, the devices shown in the following table also support the DH485 network.

Table E.4 Allen-Bradley Devices that Support DH485 Communication

Catalog Number	Description	Installation	Function	Publication
Bulletin 1761 Controllers	MicroLogix 1000	Series C or higher	These controllers support DH485 communications.	1761-6.3
Bulletin 1764	MicroLogix 1500	Series A or higher	These controllers support DH485 communications.	1764-UM001A-US-P
Bulletin 1747 Processors	SLC 500 Processors	SLC Chassis	These processors support a variety of I/O requirements and functionality.	1747-6.2
1746-BAS	BASIC Module	SLC Chassis	Provides an interface for SLC 500 devices to foreign devices. Program in BASIC to interface the 3 channels (2 RS232 and 1 DH485) to printers, modems, or the DH485 network for data collection.	1746-UM004A-US-P 1746-PM001A-US-P 1746-RM001A-US-P
1785-KA5	DH+™/DH485 Gateway	(1771) PLC Chassis	Provides communication between stations on the PLC-5□ (DH+) and SLC 500 (DH485) networks. Enables communication and data transfer from PLC® to SLC 500 on DH485 network. Also enables programming software programming or data acquisition across DH+ to DH485.	1785-6.5.5 1785-1.21
2760-RB	Flexible Interface Module	(1771) PLC Chassis	Provides an interface for SLC 500 (using protocol cartridge 2760-SFC3) to other A-B PLCs and devices. Three configurable channels are available to interface with Bar Code, Vision, RF, Dataliner™, and PLC systems.	1747-KE 2760-ND001
1784-KTX, -KTXD	PC DH485 IM	IBM XT/AT Computer Bus	Provides DH485 using RSLinx.	1784-6.5.22
1784-PCMK	PCMCIA IM	PCMCIA slot in computer and Interchange	Provides DH485 using RSLinx.	1784-6.5.19
1747-PT1	Hand-Held Terminal	NA	Provides hand-held programming, monitoring, configuring, and troubleshooting capabilities for SLC 500 processors.	1747-NP002

Table E.4 Allen-Bradley Devices that Support DH485 Communication

Catalog Number	Description	Installation	Function	Publication
1747-DTAM, 2707-L8P1, -L8P2, -L40P1, -L40P2, -V40P1, -V40P2, -V40P2N, -M232P3, and -M485P3	DTAM, DTAM Plus, and DTAM Micro Operator Interfaces	Panel Mount	Provides electronic operator interface for SLC 500 processors.	1747-6.1 2707-800, 2707-803
2711-K5A2, -B5A2, -K5A5, -B5A5, -K5A1, -B5A1, -K9A2, -T9A2, -K9A5, -T9A5, -K9A1, and -T9A1	PanelView 550 and PanelView 900 Operator Terminals	Panel Mount	Provides electronic operator interface for SLC 500 processors.	2711-802, 2711-816

NA = Not Applicable

Important DH485 Network Planning Considerations

Carefully plan your network configuration before installing any hardware. Listed below are some of the factors that can affect system performance:

- amount of electrical noise, temperature, and humidity in the network environment
- number of devices on the network
- connection and grounding quality in installation
- amount of communication traffic on the network
- type of process being controlled
- network configuration

The major hardware and software issues you need to resolve before installing a network are discussed in the following sections.

Hardware Considerations

You need to decide the length of the communication cable, where you route it, and how to protect it from the environment where it will be installed.

When the communication cable is installed, you need to know how many devices are to be connected during installation and how many devices will be added in the future. The following sections help you understand and plan the network.

Number of Devices and Length of Communication Cable

The maximum length of the communication cable is 1219m (4000 ft). This is the total cable distance from the first node to the last node in a segment. However, two segments can be used to extend the DH485 network to 2438m (8000 ft). For additional information on connections using the AIC+, refer to the *Advanced Interface Converter (AIC+) User Manual,* publication 1761-6.4.

Planning Cable Routes

Follow these guidelines to help protect the communication cable from electrical interference:

- Keep the communication cable at least 1.52m (5 ft) from any electric motors, transformers, rectifiers, generators, arc welders, induction furnaces, or sources of microwave radiation.
- If you must run the cable across power feed lines, run the cable at right angles to the lines.
- If you do not run the cable through a contiguous metallic wireway or conduit, keep the communication cable at least 0.15m (6 in.) from ac power lines of less than 20A, 0.30m (1 ft) from lines greater than 20A, but only up to 100K VA, and 0.60m (2 ft) from lines of 100K VA or more.

- If you run the cable through a contiguous metallic wireway or conduit, keep the communication cable at least 0.08m (3 in.) from ac power lines of less than 20A, 0.15m (6 in.) from lines greater than 20A, but only up to 100K VA, and 0.30m (1 ft) from lines of 100K VA or more.

  Running the communication cable through conduit provides extra protection from physical damage and electrical interference. If you route the cable through conduit, follow these additional recommendations:

  – Use ferromagnetic conduit near critical sources of electrical interference. You can use aluminum conduit in non-critical areas.

  – Use plastic connectors to couple between aluminum and ferromagnetic conduit. Make an electrical connection around the plastic connector (use pipe clamps and the heavy gauge wire or wire braid) to hold both sections at the same potential.

  – Ground the entire length of conduit by attaching it to the building earth ground.

  – Do not let the conduit touch the plug on the cable.

  – Arrange the cables loosely within the conduit. The conduit should contain only serial communication cables.

  – Install the conduit so that it meets all applicable codes and environmental specifications.

For more information on planning cable routes, see *Industrial Automation Wiring and Grounding Guidelines*, publication Number 1770-4.1.

Software Considerations

Software considerations include the configuration of the network and the parameters that can be set to the specific requirements of the network. The following are major configuration factors that have a significant effect on network performance:

- number of nodes on the network
- addresses of those nodes
- baud rate

The following sections explain network considerations and describe ways to select parameters for optimum network performance (speed). See your programming software's user manual for more information.

Number of Nodes

The number of nodes on the network directly affects the data transfer time between nodes. Unnecessary nodes (such as a second programming terminal that is not being used) slow the data transfer rate. The maximum number of nodes on the network is 32.

Setting Node Addresses

The best network performance occurs when node addresses are assigned in sequential order. Initiators, such as personal computers, should be assigned the lowest numbered addresses to minimize the time required to initialize the network. The valid range for the MicroLogix 1200 controllers is 1-31 (controllers cannot be node 0). The default setting is 1. The node address is stored in the controller Communications Status file (CS0:5/0 to CS0:5/7).

Setting Controller Baud Rate

The best network performance occurs at the highest baud rate, which is 19200. This is the default baud rate for a MicroLogix 1200 device on the DH485 network. All devices must be at the same baud rate. This rate is stored in the controller Communications Status file (CS0:5/8 to CS0:5/15).

Setting Maximum Node Address

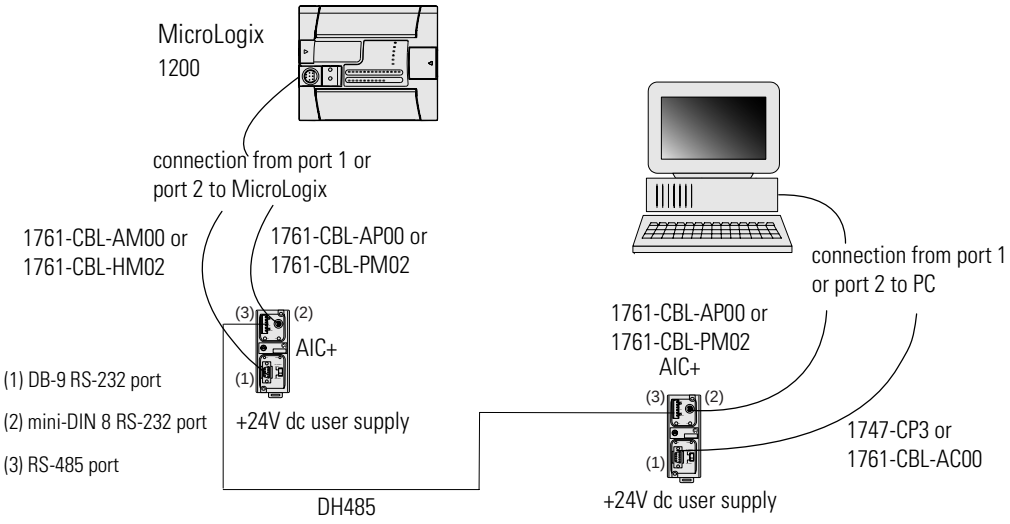
Once you have an established network set up and are confident that you will not be adding more devices, you may enhance performance by adjusting the maximum node address of your controllers. It should be set to the highest node address being used.

IMPORTANT All devices should be set to the same maximum node address.

Example DH485 Connections

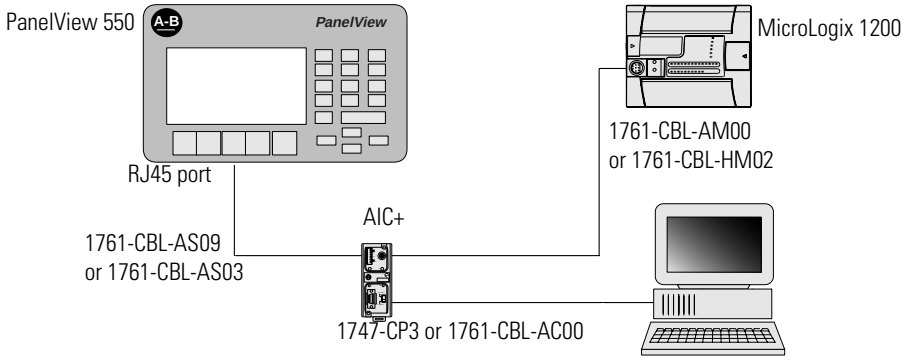
The following network diagrams provide examples of how to connect MicroLogix 1200 controllers to the DH485 network using the Advanced Interface Converter (AIC+, catalog number 1761-NET-AIC). For more information on the AIC+, see the *Advanced Interface Converter and DeviceNet Interface Installation Instructions*, Publication 1761-5.11.

DH485 Network with a MicroLogix 1200 Controller



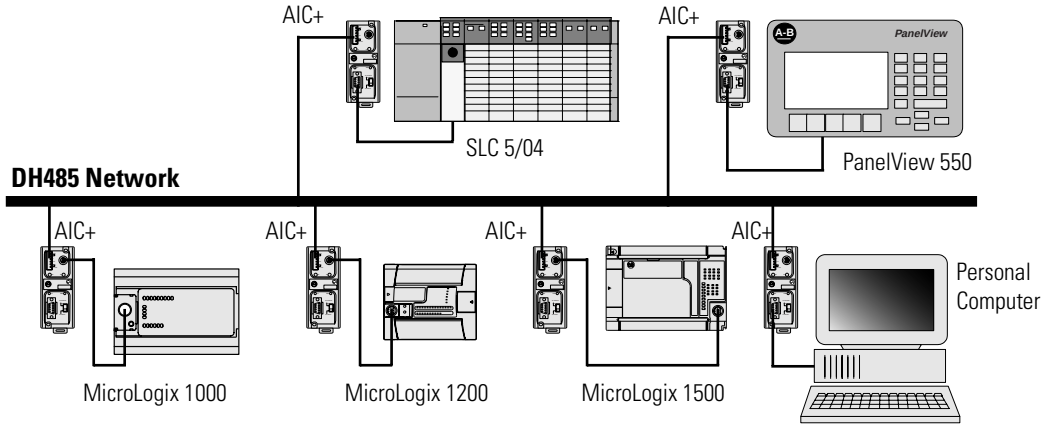
NOTE Series C or higher cables are required.

Typical 3-Node Network



NOTE This 3-node network is not expandable.

Networked Operator Interface Device and MicroLogix Controllers



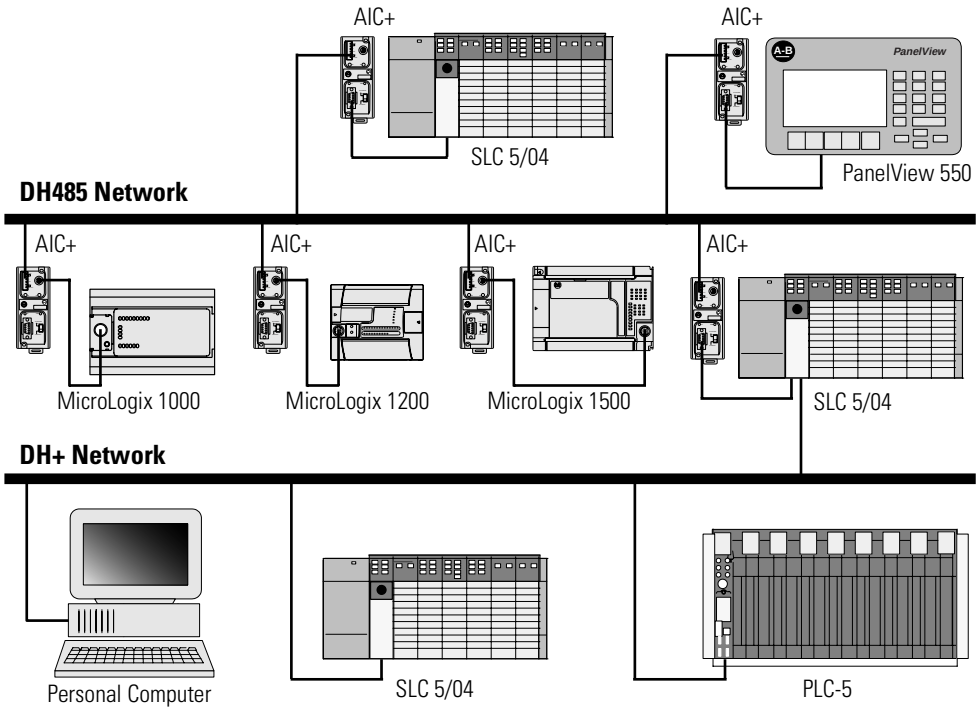
MicroLogix Remote Packet Support

MicroLogix 1200 controllers can respond and initiate with communications (or commands) that do not originate on the local DH485 network. This is useful in installations where communication is needed between DH485 and DH+ networks.

The example below shows how to send messages from a device on the DH+ network to a MicroLogix controller on the DH485 network. This method uses an SLC 5/04 processor as the bridge connection.

When using this method (as shown in the illustration below):

- PLC-5 devices can send read and write commands to MicroLogix 1200 controllers.
- MicroLogix 1200 controllers can respond to MSG instructions received.
- The MicroLogix 1200 controllers can initiate MSG instructions to devices on the DH+ network.
- PC can send read and write commands to MicroLogix 1200 controllers.
- PC can do remote programming of MicroLogix 1200 controllers.



Modbus Communication Protocol

Modbus is a Half-Duplex, master-slave communications protocol. The Modbus network master reads and writes coils and registers.

Modbus protocol allows a single master to communicate with a maximum of 255 slave devices.

For more information on the MicroLogix 1200 configuration parameters for Modbus Slave RTU (*Remote Terminal Unit* transmission mode) protocol, refer to the *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, publication 1762-RM001C-EN-P. For more information about the Modbus Slave protocol, see the Modbus Protocol Specifications (available from http://www.modicon.com/techpubs/).

Table E.5 Modbus to MicroLogix Memory Map

Modbus Addressing	Description	Valid MicroLogix Addressing		
		File Type	Data File Number	Address
0001 to 4096	Read/Write Modbus Coil Data space	Bit (B) or Integer (N)	3 to 255	bits 0 to 4095
10001 to 14096	Read-Only Modbus Contact Data space	Bit (B) or Integer (N)	3 to 255	bits 0 to 4095
30001 to 30256	Read-Only Modbus Input Register space	Bit (B) or Integer (N)	3 to 255	words 0 to 255
30501 to 30532	Modbus Communication Parameters	Communication Status Files	2	words 0 to 31
31501 to 31566	Read-Only System Status File space	Status (S)	2	words 32 to 65
40001 to 40256	Read/Write Modbus Holding Register space	Bit (B) or Integer (N)	3 to 255	words 0 to 255
41501 to 41566	Read/Write System Status File space	Status (S)	2	words 0 to 65

ASCII

ASCII provides connection to other ASCII devices, such as bar code readers, weigh scales, serial printers, and other intelligent devices.

You can use ASCII by configuring the RS-232 port, channel 0 for ASCII driver. Refer to the MicroLogix 1200 and MicroLogix 1500 Programmable Controllers Instruction Set Reference Manual, publication 1762-RM001C-EN-P for detailed configuration information.

When the channel is set to ASCII, the following parameters can be changed:

Table E.6 ASCII Channel Configuration Parameters

Parameter	Description	Programming Software Default
Baud Rate	Toggles between the communication rate of 300, 600, 1200, 2400, 4800, 9600, 19.2K, and 38.4K.	1200
Parity	Toggles between None, Odd, and Even.	None
Termination 1	Specifies the first termination character. The termination character defines the one or two character sequence used to specify the end of an ASCII line received. Setting the first ASCII termination character to undefined (\ff) indicates no ASCII receiver line termination is used.	\d
Termination 2	Specifies the second termination character. The termination character defines the one or two character sequence used to specify the end of an ASCII line received. Setting the second ASCII Termination character to undefined (\ff) and the first ASCII Termination character to a defined value (\d) indicates a single character termination sequence.	\ff
Control Line	Toggles between No Handshaking, Half-Duplex Modem, and Full-Duplex Modem	No Handshaking
Delete Mode	The Delete Mode allows you to select the mode of the "delete" character. Toggles between Ignore, CRT, and Printer. Delete Mode affects the characters echoed back to the remote device. When Delete Mode is enabled, the previous character is removed from the receive buffer. In CRT mode, when a delete character is encountered, the controller echos three characters to the device: backspace, space, and backspace. This erases the previous character on the terminal. In Printer Mode, when a delete character is encountered, the controller echos the slash character, then the deleted character. Enable the Echo parameter to use Delete Mode.	Ignore
Echo	When Echo Mode is enabled, all of the characters received are echoed back to the remote device. This allows you to view characters on a terminal connected to the controller. Toggles between Enabled and Disabled.	Disabled
XON/XOFF	Allows you to Enable or Disable XON/ XOFF software handshaking. XON/XOFF software handshaking involves the XON and XOFF control characters in the ASCII character set. When the receiver receives the XOFF character, the transmitter stops transmitting until the receiver receives the XON character. If the receiver does not receive an XON character after 60 seconds, the transmitter automatically resumes sending characters. Also, when the receive buffer is more than 80% full, an XOFF character is sent to the remote device to pause the transmission. Then, when the receive buffer drops to less than 80% full, an XON character is sent to the remote device to resume the transmission.	Disabled
RTS Off Delay (x20 ms)	Allows you to select the delay between when a transmission is ended and when RTS is dropped. Specify the RTS Off Delay value in increments of 20 ms. Valid range is 0 to 65535.	0
RTS Send Delay (x20 ms)	Allows you to select the delay between when RTS is raised and the transmission is initiated. Specify the RTS Send Delay value in increments of 20 ms. Valid range is 0 to 65535.	0

System Loading and Heat Dissipation

System Loading Limitations

When you connect MicroLogix accessories and expansion I/O, an electrical load is placed on the controller power supply. This section shows how to calculate the load and validate that the system will not exceed the capacity of the controller power supply.

The following example is provided to illustrate system loading validation. The system validation procedure accounts for the amount of 5V dc and 24V dc current consumed by controller, expansion I/O, and user-supplied equipment. Use the System Loading Worksheet on page F-3 to validate your specific 24-point controller configuration. Use the System Loading Worksheet on page F-8 to validate your specific 40-point controller.

Current consumed by the processor, memory modules, and the real-time clock modules has already been factored into the calculations. A system is valid if the current and power requirements are satisfied.

System Loading Example Calculations (24-Point Controller)

Current Loading

Table F.1 Calculating the Current for MicroLogix Accessories

Catalog Number	Device Current Requirements		Calculated Current	
	at 5V dc (mA)	at 24V dc (mA)	at 5V dc (mA)	at 24V dc (mA)
1761-NET-AIC[1] when powered by the base unit communications port, selector switch in the up position	0	120	0	120
Subtotal 1:			**0**	**120**

(1) This is an optional accessory. Current is consumed only if the accessory is installed.

Table F.2 Calculating the Current for Expansion I/O

Catalog Number(1)	n	A	B	n x A	n x B
	Number of Modules	Device Current Requirements (max)		Calculated Current	
		at 5V dc (mA)	at 24V dc (mA)	at 5V dc (mA)	at 24V dc (mA)
1762-IA8	2	50	0	100	0
1762-IQ8		50	0		
1762-IQ16		60	0		
1762-OA8		115	0		
1762-OB8		115	0		
1762-OB16		175	0		
1762-OW8	2	80	90	160	180
1762-OW16		120	140		
1762-IF2OF2		40	105		
1762-IF4		40	50		
Total Modules (6 maximum):	**4**	**Subtotal 2:**		**260**	**180**

(1) Refer to your expansion I/O Installation Instructions for Current Requirements not listed in this table.

Validating the System

The example systems shown in the tables below are verified to be acceptable configurations. The systems are valid because:

- *Calculated Current Values < Maximum Allowable Current Values*
- *Calculated System Loading < Maximum Allowable System Loading*

Table F.3 Validating Systems Using 1762-L24AWA or 1762-L24BXB

Maximum Allowable Values		Calculated Values	
Current:		Current (Subtotal 1 + Subtotal 2 from Table F.1 and Table F.2 on page F-2.):	
400 mA at 5V dc	350 mA at 24V dc	0 mA + 260 mA = 260 mA at 5V dc	120 mA + 180 mA = 300 mA at 24V dc
System Loading:		System Loading:	
10.4 Watts		= (260 mA x 5V) + (300 mA x 24V) = (1300 mW) + (7200 mW) = 8500 mW = 8.50 Watts	

Table F.4 Validating Systems using 1762-L24BWA

Maximum Allowable Values		**Calculated Values**	
Current for Devices Connected to the +24V dc Sensor Supply:		Sum of all sensor currents	
250 mA at 24V dc		140 mA at 24V dc (example sensor value)	
Current for MicroLogix Accessories and Expansion I/O:		Current Values (Subtotal 1 from Table F.1 + Subtotal 2 from Table F.2):	
400 mA at 5V dc	350 mA at 24V dc	0 mA + 260 mA = 260 mA at 5V dc	120 mA + 180 mA = 300 mA at 24V dc
System Loading:		System Loading:	
12 Watts		= (140 mA x 24V) + (260 mA x 5V) + (300 mA x 24V) = (3360 mW) + (1300 mW) + (7200 mW) = 11,860 mW = 11.9 Watts	

System Loading Worksheet

The tables below are provided for system loading validation. See System Loading Example Calculations (24-Point Controller) on page F-1.

Current Loading

Table F.5 Calculating the Current for MicroLogix Accessories

Catalog Number	**Device Current Requirements**		**Calculated Current**	
	at 5V dc (mA)	**at 24V dc (mA)**	**at 5V dc (mA)**	**at 24V dc (mA)**
1761-NET-AIC(1) when powered by the base unit communications port, selector switch in the up position	0	120		
Subtotal 1:				

(1) This is an optional accessory. Current is consumed only if the accessory is installed.

Table F.6 Calculating the Current for Expansion I/O

Catalog Number(1)	n	A	B	n x A	n x B
	Number of Modules	**Device Current Requirements**		**Calculated Current**	
		at 5V dc (mA)	**at 24V dc (mA)**	**at 5V dc (mA)**	**at 24V dc (mA)**
1762-IA8		50	0		
1762-IQ8		50	0		
1762-IQ16		60	0		
1762-OA8		115	0		
1762-OB8		115	0		
1762-OB16		175	0		
1762-OW8		80	90		
1762-OW16		120	140		
1762-IF2OF2		40	105		
1762-IF4		40	50		
Total Modules (6 maximum):		**Subtotal 2:**			

(1) Refer to your expansion I/O Installation Instructions for Current Requirements not listed in this table.

Table F.7 Validating Systems using 1762-L24AWA or 1762-L24BXB

Maximum Allowable Values		**Calculated Values**	
Current:		Current (Subtotal 1 from Table F.5 + Subtotal 2 from Table F.6.):	
400 mA at 5V dc	350 mA at 24V dc	mA at 5V dc	mA at 24V dc
System Loading:		System Loading:	
10.4 Watts		= (_____ mA x 5V) + (_____ mA x 24V) = _____ mW + _____ mW = _____ mW = _____ W	

Table F.8 Validating Systems using 1762-L24BWA

Maximum Allowable Values		**Calculated Values**	
Current for Devices Connected to the +24V dc Sensor Supply:		Sum of all sensor currents Include 1761-NET-AIC here rather than in TableF.5, if it is powered externally by the sensor supply	
250 mA at 24V dc			mA at 24V dc
Current for MicroLogix Accessories and Expansion I/O:		Current (Subtotal 1 from Table F.5 + Subtotal 2 from Table F.6.)	
400 mA at 5V dc	350 mA at 24V dc	mA at 5 V dc	mA at 24V dc
System Loading:		System Loading:	
12 Watts		= (_____ mA x 24V) + (_____ mA x 5V) + (_____ mA x 24V) = _____ mW + _____ mW + _____ mW = _____ mW = _____ W	

System Loading Example Calculations (40-Point Controller)

Current Loading

Table F.9 Calculating the Current for MicroLogix Accessories

Catalog Number	**Device Current Requirements**		**Calculated Current**	
	at 5V dc (mA)	**at 24V dc (mA)**	**at 5V dc (mA)**	**at 24V dc (mA)**
1761-NET-AIC(1) when powered by the base unit communications port, selector switch in the up position	0	120	0	120
Subtotal 1:			**0**	**120**

(1) This is an optional accessory. Current is consumed only if the accessory is installed.

Table F.10 Calculating the Current for Expansion I/O

Catalog Number(1)	n	A	B	n x A	n x B
	Number of Modules	**Device Current Requirements (max)**		**Calculated Current**	
		at 5V dc (mA)	**at 24V dc (mA)**	**at 5V dc (mA)**	**at 24V dc (mA)**
1762-IA8		50	0		
1762-IQ8		50	0		
1762-IQ16	2	60	0	120	0
1762-OA8	1	115	0	115	0
1762-OB8		115	0		
1762-OB16		175	0		
1762-OW8		80	90		
1762-OW16	1	120	140	120	140
1762-IF2OF2	1	40	105	40	105
1762-IF4		40	50		
Total Modules (6 maximum):	**6**	**Subtotal 2:**		**395**	**245**

(1) Refer to your expansion I/O Installation Instructions for Current Requirements not listed in this table.

Validating the System

The example systems shown in Table F.11 and Table F.12 are verified to be acceptable configurations. The systems are valid because:

- *Calculated Current Values < Maximum Allowable Current Values*
- *Calculated System Loading < Maximum Allowable System Loading*

Table F.11 Validating Systems using 1762-L40AWA or 1762-L40BXB

Maximum Allowable Values		**Calculated Values**	
Current:		Current (Subtotal 1 from Table F.9 + Subtotal 2 from Table F.10):	
600 mA at 5V dc	500 mA at 24V dc	0 mA + 395 mA = 395 mA at 5V dc	120 mA + 245 mA = 365 mA at 24V dc
System Loading:		System Loading:	
15 Watts		= (395 mA x 5V) + (365 mA x 24V) = (1975 mW) + (8760 mW) = 10,735 mW = 10.74 Watts	

Table F.12 Validating Systems using 1762-L40BWA

Maximum Allowable Values		**Calculated Values**	
Current for Devices Connected to the +24V dc Sensor Supply:		Sum of all current sensors	
400 mA at 24V dc		150 mA at 24V dc (example sensor value)	
Current for MicroLogix Accessories and Expansion I/O:		Current (Subtotal 1 from Table F.9 + Subtotal 2 from Table F.10):	
600 mA at 5V dc	500 mA at 24V dc	0 mA + 395 mA = 395 mA at 5V dc	120 mA + 245 mA = 365 mA at 24V dc
System Loading:		System Loading:	
16 Watts		= (150 mA x 24V) + (395 mA x 5V) + (365 mA x 24V) = (3600 mW) + (1975 mW) + (8760 mW) = 14335 W = 14.34 Watts	

System Loading Worksheet

The tables below are provided for system loading validation. See System Loading Example Calculations (40-Point Controller) on page F-5.

Current Loading

Table F.13 Calculating the Current for MicroLogix Accessories

Catalog Number	**Device Current Requirements**		**Calculated Current**	
	at 5V dc (mA)	**at 24V dc (mA)**	**at 5V dc (mA)**	**at 24V dc (mA)**
1761-NET-AIC(1) when powered by the base unit communications port, selector switch in the up position	0	120		
Subtotal 1:				

(1) This is an optional accessory. Current is consumed only if the accessory is installed.

Table F.14 Calculating the Current for Expansion I/O

Catalog Number(1)	n	A	B	n x A	n x B
	Number of Modules	**Device Current Requirements**		**Calculated Current**	
		at 5V dc (mA)	**at 24V dc (mA)**	**at 5V dc (mA)**	**at 24V dc (mA)**
1762-IA8		50	0		
1762-IQ8		50	0		
1762-IQ16		60	0		
1762-OA8		115	0		
1762-OB8		115	0		
1762-OB16		175	0		
1762-OW8		80	90		
1762-OW16		120	140		
1762-IF2OF2		40	105		
1762-IF4		40	50		
Total Modules (6 maximum):		**Subtotal 2:**			

(1) Refer to your expansion I/O Installation Instructions for Current Requirements not listed in this table.

Table F.15 Validating Systems using 1762-L40AWA or 1762-L40BXB

Maximum Allowable Values		**Calculated Values**	
Current:		Current (Subtotal 1 from Table F.13 + Subtotal 2 from Table F.14.):	
600 mA at 5V dc	500 mA at 24V dc		
System Loading:		System Loading:	
15 Watts		= (_____ mA x 5V) + (_____ mA x 24V) = _____ mW + _____ mW = _____ mW = _____ W	

Table F.16 Validating Systems using 1762-L40BWA

Maximum Allowable Values		**Calculated Values**	
Current for Devices Connected to the +24V dc Sensor Supply:		Sum of all sensor currents Include 1761-NET-AIC here rather than in Table F.13, if it is powered externally by the sensor supply	
400 mA at 24V dc			mA at 24V dc
Current for MicroLogix Accessories and Expansion I/O:		Current (Subtotal 1 from Table F.13 + Subtotal 2 from page Table F.14.):	
600 mA at 5V dc	500 mA at 24V dc	mA at 5 V dc	mA at 24V dc
System Loading:		System Loading:	
16 Watts		= (_____ mA x 24V) + (_____ mA x 5V) + (_____ mA x 24V) = _____ mW + _____ mW + _____ mW = _____ mW = _____ W	

Calculating Heat Dissipation

Use the following table when you need to determine the heat dissipation of your system for installation in an enclosure. For System Loading, take the value from the appropriate system loading worksheets on pages F-3, F-5, F-7 or F-9:

Table F.17 Heat Dissipation

Catalog Number	Heat Dissipation		
	Equation or Constant	Calculation	Sub-Total
1762-L24AWA	15.2W + (0.4 x System Loading)	15.2W + (0.4 x _____ W)	W
1762-L24BWA	15.7W + (0.4 x System Loading)	15.7W + (0.4 x _____ W)	W
1762-L24BXB	17.0W + (0.3 x System Loading)	17.0W + (0.3 x _____ W)	W
1762-L40AWA	21.0W + (0.4 x System Loading)	21.0W + (0.4 x _____ W)	W
1762-L40BWA	22.0W + (0.4 x System Loading)	22.0W + (0.4 x _____ W)	W
1762-L40BXB	27.9W + (0.3 x System Loading)	27.9W + (0.3 x _____ W)	W
1762-IA8	2.0W x number of modules	2.0W x _____	W
1762-IQ8	3.7W x number of modules	3.7W x _____	W
1762-IQ16	5.3W x number of modules	5.3W x _____	W
1762-OA8	2.9W x number of modules	2.9W x _____	W
1762-OB8	1.6W x number of modules	1.6W x _____	W
1762-OB16	2.9W x number of modules	2.9W x _____	W
1762-OW8	2.9W x number of modules	2.9W x _____	W
1762-OW16	5.6W x number of modules	5.6W x _____	W
1762-IF2OF2	2.6W x number of modules	2.6W x _____	W
1762-IF4	2.0W x number of modules	2.0W x _____	W
Add Sub-Totals to determine Heat Dissipation			**W**

The following terms are used throughout this manual. Refer to the *Allen-Bradley Industrial Automation Glossary*, Publication Number AG-7.1, for a complete guide to Allen-Bradley technical terms.

address
A character string that uniquely identifies a memory location. For example, I:1/0 is the memory address for the data located in the Input file location word1, bit 0.

AIC+ Advanced Interface Converter
A device that provides a communication link between various networked devices. (Catalog Number 1761-NET-AIC.)

application
1) A machine or process monitored and controlled by a controller.
2) The use of computer- or processor-based routines for specific purposes.

baud rate
The speed of communication between devices. All devices must communicate at the same baud rate on a network.

bit
The smallest storage location in memory that contains either a 1 (ON) or a 0 (OFF).

block diagrams
A schematic drawing.

Boolean operators
Logical operators such as AND, OR, NAND, NOR, NOT, and Exclusive-OR that can be used singularly or in combination to form logic statements or circuits. Can have an output response of T or F.

branch
A parallel logic path within a rung of a ladder program.

communication scan
A part of the controller's operating cycle. Communication with other devices, such as software running on a personal computer, takes place.

controller
A device, such as a programmable controller, used to monitor input devices and control output devices.

controller overhead
An internal portion of the operating cycle used for housekeeping and set-up purposes.

control profile
The means by which a controller determines which outputs turn on under what conditions.

counter
1) An electro-mechanical relay-type device that counts the occurrence of some event. May be pulses developed from operations such as switch closures or interruptions of light beams.
2) In controllers, a software counter eliminates the need for hardware counters. The software counter can be given a preset count value to count up or down whenever the counted event occurs.

CPU (Central Processing Unit)
The decision-making and data storage section of a programmable controller.

data table
The part of processor memory that contains I/O values and files where data is monitored, manipulated, and changed for control purposes.

DIN rail
Manufactured according to Deutsche Industrie Normenausshus (DIN) standards, a metal railing designed to ease installation and mounting of your controller.

download
Data is transferred from a programming or storage device to another device.

DTE (Data Terminal Equipment)
Equipment that is attached to a network to send or receive data, or both.

embedded I/O
Embedded I/O is the controller's on-board I/O.

EMI
Electromagnetic interference.

encode
1) A rotary device that transmits position information.
2) A device that transmits a fixed number of pulses for each revolution.

executing mode
Any run or test mode.

expansion I/O
Expansion I/O is I/O that is connected to the controller via a bus or cable. MicroLogix 1200 controllers use Bulletin 1762 expansion I/O.

false
The status of an instruction that does not provide a continuous logical path on a ladder rung.

FIFO (First-In-First-Out)
The order that data is entered into and retrieved from a file.

file
A collection of information organized into one group.

full-duplex
A bidirectional mode of communication where data may be transmitted and received simultaneously (contrast with half-duplex).

half-duplex
A communication link in which data transmission is limited to one direction at a time.

hard disk
A storage area in a personal computer that may be used to save processor files and reports for future use.

high byte
Bits 8 to 15 of a word.

input device
A device, such as a push button or a switch, that supplies signals to the input circuits of the controller.

inrush current
The temporary surge current produced when a device or circuit is initially energized.

instruction
A mnemonic and data address defining an operation to be performed by the processor. A rung in a program consists of a set of input and output instructions. The input instructions are evaluated by the controller as being true or false. In turn, the controller sets the output instructions to true or false.

instruction set
The set of general purpose instructions available with a given controller.

I/O (Inputs and Outputs)
Consists of input and output devices that provide and/or receive data from the controller.

jump
Change in normal sequence of program execution, by executing an instruction that alters the program counter (sometimes called a branch). In ladder programs a JUMP (JMP) instruction causes execution to jump to a labeled rung.

ladder logic
A program written in a format resembling a ladder-like diagram. The program is used by a programmable controller to control devices.

least significant bit (LSB)
The digit (or bit) in a binary word (code) that carries the smallest value of weight.

LED (Light Emitting Diode)
Used as status indicator for processor functions and inputs and outputs.

LIFO (Last-In-First-Out)
The order that data is entered into and retrieved from a file.

low byte
Bits 0 to 7 of a word.

logic
A process of solving complex problems through the repeated use of simple functions that can be either true or false. General term for digital circuits and programmed instructions to perform required decision making and computational functions.

Master Control Relay (MCR)
A mandatory hard-wired relay that can be de-energized by any series-connected emergency stop switch. Whenever the MCR is de-energized, its contacts open to de-energize all application I/O devices.

mnemonic
A simple and easy to remember term that is used to represent a complex or lengthy set of information.

modem
Modulator/demodulator. Equipment that connects data terminal equipment to a communication line.

modes
Selected methods of operation. Example: run, test, or program.

negative logic
The use of binary logic in such a way that “0” represents the voltage level normally associated with logic 1 (for example, 0 = +5V, 1 = 0V). Positive is more conventional (for example, 1 = +5V, 0 = 0V).

network
A series of stations (nodes) connected by some type of communication medium. A network may be made up of a single link or multiple links.

nominal input current
The current at nominal input voltage.

normally closed
Contacts on a relay or switch that are closed when the relay is de-energized or the switch is deactivated; they are open when the relay is energized or the switch is activated. In ladder programming, a symbol that allows logic continuity (flow) if the referenced input is logic “0” when evaluated.

normally open
Contacts on a relay or switch that are open when the relay is de-energized or the switch is deactivated. (They are closed when the relay is energized or the switch is activated.) In ladder programming, a symbol that allows logic continuity (flow) if the referenced input is logic “1” when evaluated.

off-delay time
The OFF delay time is a measure of the time required for the controller logic to recognize that a signal has been removed from the input terminal of the controller. The time is determined by circuit component delays and by any filter adjustment applied.

offline
Describes devices not under direct communication.

offset
The steady-state deviation of a controlled variable from a fixed point.

off-state leakage current
When an ideal mechanical switch is opened (off-state) no current flows through the switch. Practical semiconductor switches, and the transient suppression components which are sometimes used to protect switches, allow a small current to flow when the switch is in the off state. This current is referred to as the off-state leakage current. To ensure reliable operation, the off-state leakage current rating of a switch should be less than the minimum operating current rating of the load that is connected to the switch.

on-delay time
The ON delay time is a measure of the time required for the controller logic to recognize that a signal has been presented at the input terminal of the controller.

one-shot
A programming technique that sets a bit for only one program scan.

online
Describes devices under direct communication. For example, when RSLogix 500 is monitoring the program file in a controller.

operating voltage
For inputs, the voltage range needed for the input to be in the On state. For outputs, the allowable range of user-supplied voltage.

output device
A device, such as a pilot light or a motor starter coil, that is controlled by the controller.

processor
A Central Processing Unit. (See CPU.)

processor file
The set of program and data files used by the controller to control output devices. Only one processor file may be stored in the controller at a time.

program file
The area within a processor file that contains the ladder logic program.

program mode
When the controller is not executing the processor file and all outputs are de-energized.

program scan
A part of the controller's operating cycle. During the scan the ladder program is executed and the output data file is updated based on the program and the input data file.

programming device
Executable programming package used to develop ladder diagrams.

protocol
The packaging of information that is transmitted across a network.

read
To acquire data from a storage place. For example, the processor READs information from the input data file to solve the ladder program.

relay
An electrically operated device that mechanically switches electrical circuits.

relay logic
A representation of the program or other logic in a form normally used for relays.

restore
To download (transfer) a program from a personal computer to a controller.

reserved bit
A status file location that the user should not read or write to.

retentive data
Information associated with data files (timers, counters, inputs, and outputs) in a program that is preserved through power cycles.

RS-232
An EIA standard that specifies electrical, mechanical, and functional characteristics for serial binary communication circuits. A single-ended serial communication interface.

run mode
This is an executing mode during which the controller scans or executes the ladder program, monitors input devices, energizes output devices, and acts on enabled I/O forces.

rung
Ladder logic is comprised of a set of rungs. A rung contains input and output instructions. During Run mode, the inputs on a rung are evaluated to be true or false. If a path of true logic exists, the outputs are made true. If all paths are false, the outputs are made false.

save
To upload (transfer) a program stored in memory from a controller to a personal computer; OR to save a program to a computer hard disk.

scan time
The time required for the controller to execute the instructions in the program. The scan time may vary depending on the instructions and each instruction's status during the scan.

sinking
A term used to describe current flow between an I/O device and controller I/O circuit — typically, a sinking device or circuit provides a path to ground, low, or negative side of power supply.

sourcing
A term used to describe current flow between an I/O device and controller I/O circuit — typically, a sourcing device or circuit provides a path to the source, high, or positive side of power supply.

status
The condition of a circuit or system, represented as logic 0 (OFF) or 1 (ON).

terminal
A point on an I/O module that external I/O devices, such as a push button or pilot light, are wired to.

throughput
The time between when an input turns on and the corresponding output turns on.

true
The status of an instruction that provides a continuous logical path on a ladder rung.

upload
Data is transferred to a programming or storage device from another device.

watchdog timer
A timer that monitors a cyclical process and is cleared at the conclusion of each cycle. If the watchdog runs past its programmed time period, it causes a fault.

workspace
The main storage available for programs and data and allocated for working storage.

write
To copy data to a storage device. For example, the processor WRITEs the information from the output data file to the output modules.

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